University of Alberta

Teachers and Curriculum Change: Examining an Inservice Program Implementation

by

©

Beverly Ann Krull-Romanyshyn

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education

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August 1, 1996

There can be no significant innovation in education that does not have at its center the attitudes of teachers, and it is an illusion to think otherwise. The beliefs, feelings and assumptions of teachers are the air of a learning environment; they determine the quality of life within it.

(Postman & Weingartner, 1969, p. 33)

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled Teachers and Curriculum Change: Examining an Inservice Program Implementation in partial fulfillment of the requirements for the degree of Master of Education.

H Kass

Dr. Heidi Kass (supervisor)

Dr. Ken Jacknicke

John Hoddinott

Dr. John Hoddinott

May 27, 1996

Dedication

I dedicate this study to my father Gerald Krull who is always there to believe in my dreams and to encourage me to attain them

And to the memory of

my mother, Grace Mary Krull, August 5, 1924 - August 11, 1966

my stepmother, Norma Anne Jane Krull, January 5, 1920 - July 19, 1995

and my grandmother, Gertrude Krull, September 30, 1886 - November 6, 1979

All strong and caring women who greatly influenced my life.

Abstract

What can be learned by critical reflection upon a process of teacher inservice planning, implementation and evaluation? The introduction of a centrally developed STS based senior high school science curriculum in Alberta, Canada was preceded by a three-year trial of the new curriculum and resources involving 170 teachers and 4000 students in 35 schools. The story of this inservice project is presented from three perspectives; that of the teacher participants, the project manager/researcher, and the leadership team.

Study findings, along with theories of constructivism, reflective practice, teachers' functional paradigms and change, are used to develop an inservice planning process model and summary useful to those planning inservice programs for teachers implementing central curriculum changes that call for considerable shift in teacher practice. A reflective and responsive inservice planning and implementation process was found to be effective and dependent upon leadership, communication and the development of trust and rapport within the project.

Acknowledgements

I wish to express sincere thanks and appreciation

to my advisor Dr. Heidi Kass who inspired me to begin this project and provided consistent support and encouragement as I completed it

to my husband Victor and daughters Shannon and Kristina, for their belief in me and their understanding as I worked on this project

to my colleagues, the members of the Alberta Education Science Team, for their willing participation in the project study

and to the Senior High Science Program Field Validation Teachers for their professional dedication and effort as they implemented the new Senior High Science program.

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CHAPTER 1

INTRODUCTION

Description

This study tells the story of a three-year teacher inservice project; a continuous cycle of planning, implementation and evaluation of inservice activities. The inservice project was to provide support to the 170 teachers involved in the field validation of the new senior high science curriculum in Alberta. The field validation project included the initial classroom trials of the draft programs of study, the provincially mandated curriculum documents, along with trials of the proposed basic student and teacher text resources. The project took place over three school years; 1991–92, 1992–93 and 1993–94.

The study is intended to provide information and a framework useful to teacher inservice program planners—planners charged with developing an inservice program for teachers implementing new curriculum that calls for considerable change in teacher practice.

For the past eight years (1988–1996) I have worked with Alberta Education, Curriculum Standards Branch, on various aspects of the new senior high science curriculum project. I came to Alberta Education from ten years of classroom teaching. My responsibilities with Alberta Education have been in the areas of science curriculum development, resource development and identification, and in the planning and implementation of teacher inservice programs. I was responsible for the teacher inservice component of the new senior high science program implementation in Alberta, 1990–1994. As such, I was very closely involved in the process that is the subject of this study.

Guiding Questions

1. What can be learned through critical reflection upon this three-year process of inservice planning, implementation and evaluation?

2. How do the theories related to constructivism, reflective practice and teachers' functional paradigms and theories of change provide a useful framework for the analysis and interpretation of this inservice process?

3. Using aspects of the theoretical framework and the findings of this study, can a useful framework for teacher inservice planners be developed?

Research Design

I have chosen a case study research design to tell the story of the inservice project and to address the questions I have posed. This case study narrative is descriptive, interpretative and evaluative as the story and critique of the inservice process unfolds and the development of a framework for future planners is undertaken.

Data sources for this study include:

- official Alberta Education documents related to this project
- personal documentation of the inservice planning, implementation and evaluation process
- journal comments from field validation teachers who participated in the inservice activities provided by Alberta Education over the three-year project
- personal recollections of formal and informal conversations with teacher participants, inservice session leaders, colleagues and the various partners in the planning, implementation and evaluation of the teacher inservice activities.

Although the study is primarily qualitative, simple quantitative analysis techniques are employed in the consideration of the field validation teachers' journal comments.

Three perspectives on the project are presented within this study.

Perspective 1: Personal

My personal reflections on this project include my views as Alberta Education project manager, as classroom teacher, as educational researcher and as a mother. The Alberta Senior High Science curriculum development, field validation and inservice project provide the context for my reflections—a project designed to support a curriculum change calling for considerable change in teacher practice. Alberta Education documents associated with this project collected over the three years were used to track the process of planning, implementation, interpretation, analysis and evaluation of the inservice program. Information from these sources is interwoven with my personal comments on the project process.

Perspective 2: Field Validation Teachers

Field Validation Teachers' inservice journal comments, made during the major blocks of inservice activity over the three years of the project, are a major source of data used in this study. The journal comments were the only source of data subjected to formal analysis, using quantitative methods. Additional data that informed my comment in this study included inservice needs assessment surveys, teleconference minutes, inservice session evaluation forms, taped inservice sessions and notes from field validation school visits.

Personal Journals were provided for participants to complete in the **Year One**, **Year Two** and **Year Three** inservice sessions. Appendix A presents a complete **Year One** (Science 10) journal and the cover and first Initial Perceptions page for the **Year Two** and **Year Three** journals. Teachers' comments on the *Initial Perceptions* pages of these journals provided the data for the formal analysis undertaken in this study. The teacher comments relating to four rounds of inservice activities held in June 1991, August 1991, June 1992 and June 1993 were entered and printed in summary documents. This information was used during the project for ongoing inservice evaluation and planning and later for the research analysis done in this study.

Analysis of the journal comments involved establishing potential comment categories, categorizing comments, possible revision of categories and examination of the relationship of the comments in the various categories established. To illustrate the nature of the comments in each category, sample journal entries from each of the various categories are provided. The percentage of teacher comments in each category were then determined, graphed, analyzed and discussed as part of this study.

Perspective 3: Alberta Education Science Team Colleagues

Eight Alberta Education Science Team members, in addition to myself, were involved in the planning and provision of leadership for the inservice activities over the term of the project. Four members of this team, and classroom teachers seconded from Alberta school jurisdictions, returned to the classroom and have since been teaching the new senior high science programs. One team member, seconded from the Faculty of Science, University of Alberta, returned to research and teaching activities at the university. I conducted a group interview with the eight team members to gain their perspective on the inservice and implementation project. Interview questions were drafted after the teachers' journal comments were analyzed. The group interview was 1 hour and 15 minutes in length and was audiotaped and videotaped for later analysis. Appendix B presents a list of the positions and service details for the members of the Alberta Education Science Team who participated in the group interview, the interview questions and the interview transcript.

Study Structure

The context for this study is presented in two chapters; the background related to the Alberta senior high science curriculum development and implementation project is presented in Chapter 2, and my personal background is presented in Chapter 4.

A survey of literature related to this study is presented in Chapter 3. The survey provides a pertinent research base and then builds upon it within the context of the story. The survey includes a review of research on educational change as related to curricular reform, teacher attitudes, constructivist theory, reflective practice, teachers' functional paradigms, action research and grounded theory. Consideration of constructivist theory (Prawat, 1992), reflective practice (Schon, 1987), teachers' functional paradigms (Crocker, 1983; Lantz & Kass, 1987) and of the concept of teacher as "change agent" (Fullan, 1993), provide a theoretical background for the analytic reflection in this study.

Chapter 5 presents the inservice project story from the three perspectives previously described. Data is presented, analyzed, discussed and interpreted in this chapter while the story of the project moves ahead.

Discussion of the implications of this study useful to inservice planners, teachers and educational researchers are presented in the closing chapter. A framework for planning inservice activities is presented and serves to pull together the findings of this study. Some questions and directions for further research are explored and some important personal views are presented.

Definition of Terms

The following terms are used extensively in this study.

Science Team

The Science Team was a group of science educators brought together by Alberta Education, the provincial government ministry of education, to develop and implement a new senior high science curriculum in Alberta. This team included the senior high science program manager, and program consultants for each of Science 10–20–30, Biology 20–30, Chemistry 20–30 and Physics 20–30, along with an inservice and implementation manager (myself), two resource and inservice consultants who assisted me and the Science 30 Diploma Examination Manager. A list of the Science Team members positions with specific service details is presented in Appendix B.

Senior High School Science Vision Statement

The Senior High School Science Vision Statement is a one-page document that appears as the first page of all senior high school science programs of study. It was developed by the Science Team to express the common rationale, philosophy and curriculum directions that prevail across all the new science programs. The Vision is expressed in relation to the student defining the expected student outcomes, benefits and responsibilities in a general manner. The Vision Statement: Senior High Science Programs is presented in Appendix G on the first page of the Science 10 Course of Studies.

Program of Studies/Course of Studies

In Alberta, the Program of Studies is the legal curriculum document for a particular program, such as the senior high school science program. Once approved by the Minister of Education, a program of studies (that may include one or more courses of study) becomes the curriculum that Alberta teachers are legally mandated to teach in their classroom. As an example, the Science 10–20–30 program of studies is composed of the Science 10, Science 20 and Science 30 courses of study. The Science 10 Course of Studies (Unit 1) is presented in Appendix G. The major components of all the senior high science programs or courses of study are: vision statement, course rationale and philosophy, general learner expectations (attitudes, knowledge, skills, connections among science, technology and society) and specific learner expectations (major concepts, knowledge, skills and STS connections).

STS Contexts/Connections among Science, Technology and Society

One of the major features of the new science curriculum development in Alberta was the inclusion of a required science, technology and society component to serve as a real-life link and learning context for students. This component is often referred to as the "STS Connections" component of the program because in the program of studies a column with that heading provides teachers with examples of appropriate science, technology and society contexts that could be used to develop the major concepts, skills and attitudes of the program. Definite objectives for the consideration of the connections among science, technology and society are set out in the general learning expectations for each program and in the general and specific learner expectations of each course of studies. The Unit 1 sample of the Science 10 Course of Studies presented in Appendix G includes the general and specific learner expectations related to the STS component of the program.

Diploma Examinations

The Student Evaluation Branch of Alberta Education sets standardized provincial final examinations for the graduation level of all academic core subjects and French. Diploma examinations are administered twice a year for language arts, social studies, mathematics, science, chemistry, physics, biology and French. A student's final mark in the graduation level of a diploma examination subject (Grade 12 or the 30 level) is a blended mark made up of 50% of the teacher-awarded course mark and 50% of the diploma examination mark. A student's final standing in diploma examination courses is the primary factor that post-secondary institutions consider when students are seeking admission. Alberta Education requires that a student receive a minimum grade of 50% in a graduation level language arts, mathematics, science and social studies course in order to be granted a High School Graduate Diploma. Consequently, the diploma examinations are viewed as extremely important by teachers, students, education administrators and parents.

Field Validation

Alberta Education generally runs a field validation project lead by a development and implementation team for any new curriculum that they develop. A field validation is the trial or a pilot phase of any new program and/or student and teacher resource development that is run in selected schools. Teachers identified as field validation teachers implement the new curriculum and resources in their classrooms and provide Alberta Education with information on how the new program and resources are working with students. The teachers' advice is used to improve the draft programs of study and any student or teacher resources that may be in development.

Field Validation Teacher

A field validation teacher is any teacher who is participating in the field validation project associated with a new curriculum development.

Teacher Inservice

Teacher inservice is the term used to describe the professional development activities provided for active classroom teachers. Such inservice activities are usually associated with the introduction of a new curriculum and are provided to help prepare teachers to implement such new programs in their classrooms. Alberta Education has the responsibility to provide teacher inservice activities to all field validation teachers who are piloting a new curriculum, such as the new senior high science curriculum described in this study.

Cascade Model

In Alberta, a model of teacher inservice provision that has been commonly used is termed the "cascade model". This model involves teacher inservice being provided to a core of teachers (in Alberta, generally the field validation teachers) who, in turn, are expected to provide inservice leadership to other teachers in their various school jurisdictions or schools with those teachers, in turn, expected to assist other teachers, and so on. I have heard this model being called the "trickle down effect" and it is not viewed by teachers, educational administrators or teacher professional organizations as a very effective means of preparing teachers for implementation of new curriculum that calls for considerable change in teacher practice.

Field Validation Teacher Journal

In the senior high science inservice and implementation project, field validation teachers were provided with a "field validation teacher journal" at each of the three major rounds of inservice activity provided by Alberta Education. This journal was a document that provided room for teachers to complete various lead-in statements as a method of determining their thoughts and feeling regarding the new curriculum and resources, but more importantly on the inservice sessions they experienced. These journals were designed to illicit from teachers information that would allow the Science Team to evaluate the effectiveness of the inservice provided and to make changes in future sessions to better meet the needs of the teachers involved in the project. A sample field validation teacher journal for **Year One** of the inservice project is presented in Appendix A.

Callback Sessions

A callback session is the term used to describe a short day-long inservice session offered for field validation teachers in addition to the major blocks of inservice provided. For the senior high science project described in this study, 3 to 5 day sessions of teacher inservice were offered before school began in each of the three years the project spanned. A day-long callback session was offered for these teachers only once in the middle of **Year One** to provide additional professional development opportunities.

Information Sessions

Alberta Education generally offers day-long information sessions on any new curriculum to be implemented in the province. These sessions are provided for teachers and school jurisdiction curriculum leaders and administrators who have not been involved in the field validation of the new curriculum. Information sessions provide participants with an overview of the new curriculum, resources and student evaluation, and an opportunity for discussion and questions.

These sessions were generally offered in five major centres across the province: Grande Prairie, Edmonton, Red Deer, Calgary and Lethbridge. In the case of the senior high science implementation project, the Science Team and selected field validation teachers offered such sessions in each of the three years of the field validation project. Although Alberta Education presented these daylong sessions, school jurisdictions were responsible for assuring that their teachers, curriculum leaders and administrators attended—they had to cover all travel or substitute teacher costs involved.

Ethical Considerations

To assure the ethical considerations associated with my study were met, I obtained written permission from Alberta Education to use the following data sources:

- official and unofficial documents relevant to the senior high science field validation inservice project and other inservice activities for senior high teachers that paralleled this project (includes items such as, planning documents, needs assessment summaries, teleconference minutes, field validation reports, inservice agendas and workshop descriptions)
- field validation teachers journal responses to the four rounds of inservice provided by Alberta Education.

A letter requesting permission to use such materials to the Director, Curriculum Standards Branch with signed approval is presented in Appendix C.

Before the group interview with my Science Team colleagues was undertaken all participants were provided with a letter requesting participation. The letter clearly defined the interview participation expectations and the intended use of the interview material gathered. A consent form accompanying the letter granting me permission to videotape and audiotape the interview and to use their interview comments in this study was signed by all participants and submitted to me. A copy of the letter and consent form are presented in Appendix C.

Validity

My recollections and views of the inservice project are described in this study. The presentation and consideration of the perspectives of the teacher participants and the Science Team members provides triangulation; two views of the project beyond my own. Access and reference to numerous official and unofficial documents associated with the project served to increase the accuracy of project details provided. The study is the story of a project that I managed over a period of almost four years. The length and depth of direct involvement with the project, particularly with the teachers and the Science Team, maximizes the validity of my observations. Chapter 4 traces the evolution of my beliefs regarding education revealing my personal bias. This case study is primarily my view and my interpretations of others views on the project process. As the reader, you will judge the validity of the study determining if a credible account and interpretation is presented and whether the study rings true with your life experiences.

Delimitations

This study will be limited to consideration of the Alberta Education, Curriculum Standards, Branch Senior High Science Field Validation Teacher Inservice Project, January 1991 through June, 1994. It will chronicle the planning, implementation and evaluation process for four major inservice sessions held in June 1991, August 1991, June 1992 and June 1993. It will not deal with the planning, implementation and evaluation of various information and professional development activities provided for Alberta teachers who were not directly involved in the field validation project. The planning, provision and evaluation of these information sessions at various sites across the province in the spring of 1991, 1992 and 1993, at teachers conventions and at the Alberta Teachers' Association Science Council Conferences in the fall of 1990, 1991, 1992 and 1993, was an important part of implementation support for Alberta teachers who were not involved in the field validation process. This component of inservice activity, a major part of my task and that of the Science Team, will not be considered in detail within this study. Insights and information from these parallel initiatives within the Senior High Science implementation project, are included in some places to illustrate points or to provide links helpful in discussions in this study.

Individual interviews with field validation teachers who participated in the inservice activities and classroom observations of field validation teachers implementing the new senior high science programs were not done as part of this study. These two aspects are beyond the scope of this study. Such additions would have increased the validity of the findings and provided additional perspectives on the inservice project. However, extensive data is already available, working with that data was sufficiently challenging and the possibility of providing useful research information was high. For these reasons I have made the decision to delimit the study to the data sources and perspectives described.

Limitations

It is difficult to look back on a three-year process and accurately recall one's initial perceptions of the project. Involvement in this project was a continuous personal and professional growth experience for me. The time lag between the actual project and the telling of the story within this study posed the challenge of accurate reconstruction of my thoughts at the time. The practice of keeping a personal journal on the project would have provided a more accurate record of my reflections, but this was not done. Although details of the process are most certainly forgotten, I believe the major events and important specifics are vivid in my memory. By combining my memories with the extensive documentation available, and using perception checks with my Science Team colleagues, I will present a credible account of the process.

Separation of my initial perceptions as a classroom teacher coming to the project from my perceptions as project manager during the process, and later my perspective as an educational researcher, is also difficult. Although, in reality, the three perspectives do overlap, I discuss them individually within this study.

Related Studies

Several studies that examine different facets of the Alberta Secondary Science curriculum development and implementation (Grades 7–12) have been completed in recent years.

The first of these studies considers the implementation of the Science Technology Society (STS) component of the new Alberta Junior High Science curriculum.

- Roscoe, K. (1993). STS in the Classroom: An Interpretive Study—Ph.D. Dissertation—Edmonton, Alberta: University of Alberta.

The three studies and one paper listed below examine aspects of the Alberta senior high science curriculum development and implementation. David Blades, a colleague of several members of the Alberta Education Senior High Science Team, worked at Alberta Education while completing his Ph.D. at the University of Alberta. Former Alberta Education Science Team members are the researchers who authored the remaining documents: Stella Kilian-Shrum (chemistry/integrated science) and Desiree Hackman (inservice and implementation, and resources), Raja Panwar (senior high science program manager) and John Hoddinott, (biology/integrated science). At the time of publication of this study, the Hackman masters thesis cited below was not complete but was in the final stages of development.

- Blades, D. (1994). Power and Possibilities for Change in Science Education Curriculum—Discourse. Ph.D. Dissertation - Edmonton, Alberta: University of Alberta.
- Hackman, D. (Masters Thesis in Progress). A Contemporary, Evolving Curriculum Development Model: A Case Study of the Development and Implementation of Alberta's Senior High Science Programs. Edmonton, Alberta: University of Alberta.
- Killian-Shrum, Stella (1996). An Investigation into the Implementation of a High School Science Program with an STS Dimension. Masters Thesis - Edmonton, Alberta: University of Alberta.
- Panwar, R. & Hoddinott, J. (1995). The influence of academic scientists and technologists on Alberta's secondary science curriculum policy and programme. International Journal of Science Education 1995, Vol 17(4), 505–518.

Together these studies provide a detailed examination of the recent secondary science curriculum development and implementation in Alberta, with particular focus on the senior high science curriculum area. I have reviewed these studies and refer to them where applicable in this study.

Significance

Many factors are involved in the successful implementation of new curricula, the most important factor being the classroom teacher. Unless an individual teacher believes a curriculum change is beneficial to students, meaningful change in their classroom practice is unlikely. Effective inservice activities are an important component in the process of teacher change. Reflection on this project coupled with analysis of the available data will reveal the project strengths and weaknesses, and will serve to inform others faced with the challenge of implementing a major centrally developed curriculum change.

CHAPTER 2

PROVIDING THE CONTEXT

This chapter begins with a discussion of centrally developed curriculum and teachers' functional paradigms, the theoretical construct used in this study to develop a model for inservice planning. As this study deals with the teacher inservice component associated with the implementation of a new senior high science curriculum in Alberta, Canada, the context for that development, is provided. Specific information on how education is administered and curriculum is developed in Alberta is followed by a summary of the senior high science curriculum development and implementation project.

Centrally Developed Curriculum

In many parts of the world, school curricula are developed and mandated by a central government agency. Such curricula define what students are expected to learn; what teachers are expected to teach. Development of these programs can involve extensive consultation with teachers and other stakeholders in education, or very little consultation beyond the designated curriculum development individual or group. The form these curricula take vary from a concise general program outline to an extensive and detailed program of studies complemented by government authorized student and teacher resources. Student achievement standards are often associated with such centralized curricula. Student achievement is assessed through various combinations of classroom teacher assessments, standardized government examinations and, in science, specifically required performance-based tasks.

How such centrally developed curricula are implemented in the classroom depends partly on the specificity of the mandated curriculum documents and on the assessment standard procedures in operation. The pressure on teachers to conform to mandated curriculum varies with the assessment and evaluation practices in place and this pressure can be quite strong. However, a critical factor in any curriculum implementation is view of the classroom teacher.

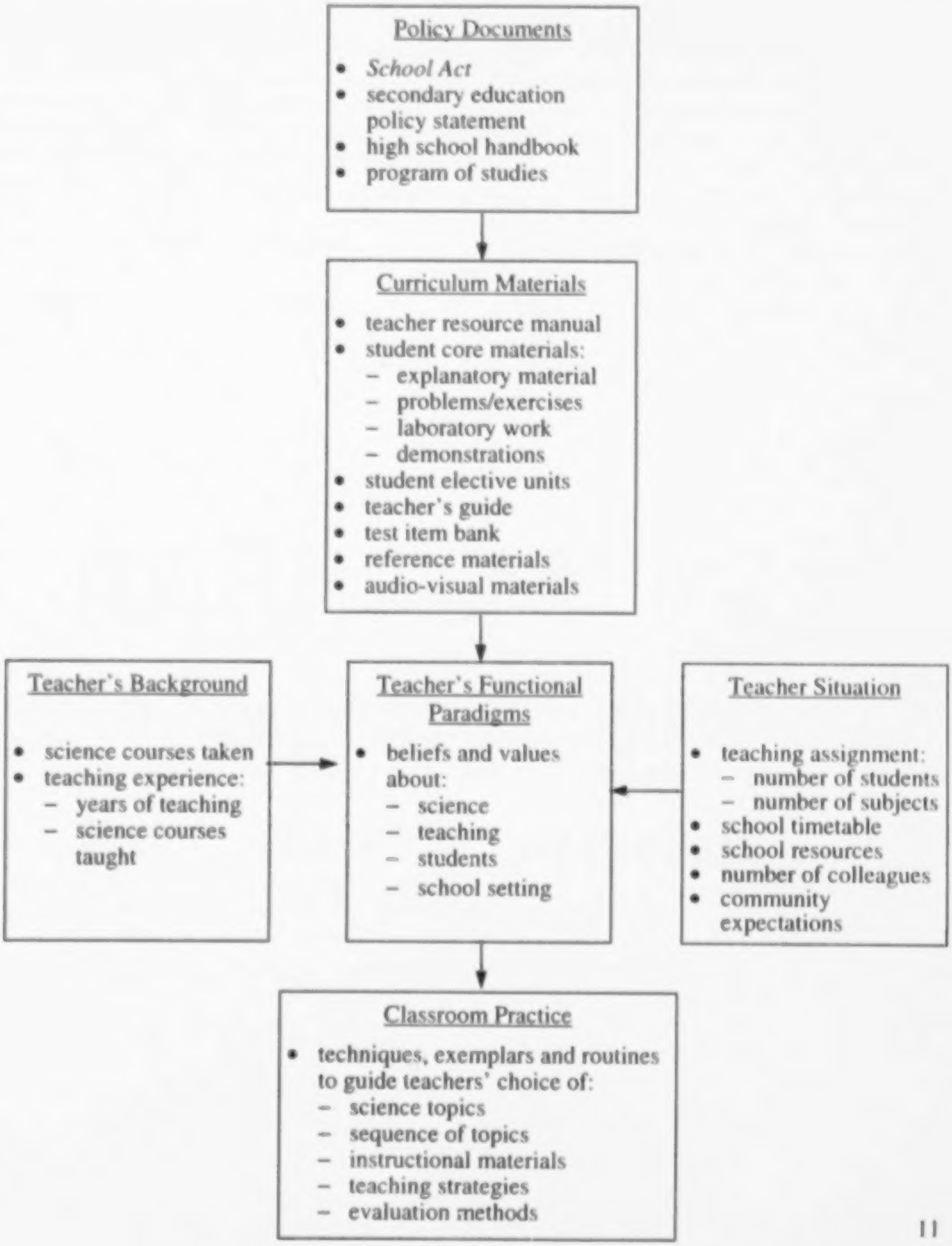
Teachers' Functional Paradigms

The keys to new curriculum implementation are teacher beliefs regarding teaching and learning. This complex set of beliefs based upon their practical knowledge as teachers defines or comprises a teacher's "functional paradigm" and is the foundation of classroom practice.

Functional Paradigm: the constellation of beliefs, values, techniques, exemplars and routines shared by a group of teachers and used by them to guide their classroom practice. (Lantz and Kass, 1987, p. 121)

The "curriculum as lived—what actually happens in the classroom—is directly related to the teacher's functional paradigm. Teachers' functional paradigms may or may not align well with the "curriculum as written". Depending on circumstance a teacher's functional paradigm can remain relatively static, be modified or even be replaced if a teacher believes major change to their belief structure is appropriate. Constructivist approaches to teaching and learning involving critical reflection on practice and ongoing examination and refinement of a teacher's "functional paradigm". It is this process that holds the greatest potential for meaningful change in classroom practice. Figure 2.1, adapted by Dr. Oliver Lantz for use in the project teacher inservice sessions, presents a model showing the factors influencing and influenced by a teacher's functional paradigm.

Figure 2.1 - Model of Teacher Interpretation of Curriculum Materials (adapted from Lantz & Kass, 1987)


Policy Documents
• School Act
• secondary education policy statement
• high school handbook
• program of studies
Curriculum Materials
• teacher resource manual
• student core materials:
– explanatory material
– problems/exercises
– laboratory work
– demonstrations
• student elective units
• teacher's guide
• test item bank
• reference materials
• audio-visual materials
Teacher's Background
• science courses taken
• teaching experience:
– years of teaching
– science courses taught
Teacher's Functional Paradigms
• beliefs and values about:
– science
– teaching
– students
– school setting
Teacher Situation
• teaching assignment:
– number of students
– number of subjects
• school timetable
• school resources
• number of colleagues
• community expectations
Classroom Practice
• techniques, exemplars and routines to guide teachers' choice of:
– science topics
– sequence of topics
– instructional materials
– teaching strategies
– evaluation methods

If teachers collective perception of their professional practice, their functional paradigms, does not align well with a particular curriculum change or element of that change, even the strong pressure of external examination may make little difference in their classroom practice. For example, if a teacher believes that the STS connections of the new Alberta senior high science program are basically a waste of time and that these connections take away from the learning of "real science", that teacher may chose to ignore the incorporation of STS contexts in daily classroom practice. Even though the diploma examinations test this component, teachers could spend a week or so of class time preparing their graduation level classes for STS questions on the examination without using such contexts throughout the course as a vehicle for the learning of science concepts. To change such an integral part of a teacher's belief system requires a dramatic experience; an experience that results in teachers reexamining their belief structure and concluding that the incorporation of STS contexts into their teaching practice would be desirable and beneficial. Only then is a realignment of their belief structures possible; a realignment that can lead to commitment and action toward the desired change in practice.

Education in Canada: Roles and Responsibilities

Under the Constitution of Canada (Section 93), responsibility for education falls to the individual province or territory government. Each province or territory has a ministry of education responsible for the development and provision of basic education. Individual provinces and territories have differences in curriculum requirements, differences in processes and methods to develop, adapt or adopt curriculum, and differences in the manner in which appropriate educational resources for students and teachers are developed, identified or made available. The Council of Ministers of Education, Canada (CMEC) established in 1967 provides a forum for the various ministries to communicate and potentially cooperate or coordinate in regards to formal positions or actions on major educational issues.

School Jurisdictions in Alberta

At the time of the Senior High Science Curriculum Implementation there were 181 school jurisdictions in Alberta. School jurisdictions are responsible for the administration of all the schools within their area in accordance with the *School Act* set out by Alberta Education. Each school jurisdiction in the province has an elected school board, as well as jurisdiction administrators who manage the education system within a jurisdiction that may include any number of schools. When Alberta was first settled, schools were an important element of each community and they were built through community effort and funding. In 1905, when Alberta became a province, the provincial government was given responsibility for education and provincial curriculum came into being. School jurisdictions have, up until recently, had the power to levy school taxes that supplemented the monies provided to each school jurisdiction by Alberta Education. During the senior high science curriculum implementation, amalgamation of school jurisdictions was just beginning as part of Alberta Education's plan to increase the efficiency of the education system. Currently, Alberta has 63 school jurisdictions and amalgamation efforts are almost complete. The provincial government now collects all education taxes and distributes all education monies to the jurisdictions instead of part of the monies as done previously. The tax collection changes were made in an effort to provide more equitable funding for education across the province. Previously, jurisdictions with a greater local resource base could collect more taxes and provide better education facilities and resources for their students than the poorer jurisdictions.

The Alberta Teachers' Association (ATA)

The Alberta Teachers' Association, established in 1918, is the professional organization of teachers in Alberta. It has approximately 30 300 full-time and part-time active members and about 14 000 in other categories (substitute, associate, life, student). It exists to advance the cause of education, to improve the teaching profession, to increase public interest in and support for education, and to cooperate with other bodies having similar objectives. Any person holding a teaching certificate in Alberta and employed by a school board (jurisdiction) is a member (compulsory) unless they are employed as a school principal or school jurisdiction superintendent. Fees payable are prescribed by the representative assembly on the recommendation of a provincial executive council. The ATA has very strong provincial bargaining power, negotiating teachers' salaries with each school jurisdiction in Alberta. It has responsibility for encouraging teacher professional development, involving teachers in educational policy making and in maintaining standards within the profession. Various parts of this organization provide support for teacher professional development activities, collective bargaining, and maintenance of a teacher professional code of practice (Alberta Teachers' Association, 1995).

Student Evaluation and Graduation Standards

In Alberta, senior high courses are designated by numbers that indicate the level of the course within a particular program. In a three-course sequence program, such as Science 10–20–30, the first level course of the program sequence, generally taken by students in their first year of high school (Grade 10) is designated with numbers between 10 and 16 (i.e. Science 10 or 14; Mathematics 10, 13 or 14). The level two courses (generally Grade 11) are given numbers between 20 and 25 (Science 20 or 24; Mathematics 20, 23 or 24), while the level three or graduation level of courses are designated with numbers between 30 and 35 (Science 30; Mathematics 30 or 33). Thus, the Science 10–20–30 program includes three courses at three levels with Science 30 being the graduation level course for that program. Course series numbered 10–20–30 and 31 are designed primarily for students planning entry into university or certain programs in colleges or technical schools. Course series numbered 13–23–33 are designed primarily for students planning entry into certain programs in colleges, technical schools, trade schools, or entry into employment. Course series designated 14–24 are designed primarily for students planning direct career entry into some areas of employment.

The Student Evaluation Branch, Alberta Education, has the responsibility for setting diploma examinations for the final Grade 12 graduation level of the following academic courses: Social Studies 30 and 33, English 30 and 33, Mathematics 30 and 33, Science 30, Biology 30, Chemistry 30, Physics 30, French 30. These diploma examinations are extremely important as they form 50% of a student's final mark in those Grade 12 courses. Grade 12 final marks are used by post-secondary institutions in Alberta and across Canada to determine student admission. These examinations are generally a combination of written response, multiple choice and numerical response items and are approximately 2 ½ hours in length. English is an exception with a two-hour written component and a two-hour multiple choice component, each written separately. These examinations are provincially scheduled and written under strict supervision by all Alberta students registered in and completing these courses. Completed examinations are submitted to the Student Evaluation Branch and marked by teachers under the direction of Alberta Education. An official result statement is mailed to every student from Alberta Education. The result report includes:

- teacher-awarded mark for the student's course work
- diploma examination mark
- final blended mark for the course (50% teacher awarded/50% diploma examination).

Alberta Education also provides official transcripts of students' complete school mark record to post-secondary institutions or to students upon request. A $10 fee is charged for provision of an official transcript of a student's school record.

Diploma examinations are developed, field validated and marked by classroom teachers in collaboration with Alberta Education diploma examination managers. Teachers who have taught a diploma examination science course during the school year and who have taught that course at least twice previously are eligible to mark diploma examinations. Potential teacher markers are nominated by their school jurisdictions, selected by Alberta Education and brought into Edmonton to work with an Alberta Education diploma examination manager and teacher chief and head markers for each subject. The diploma examination questions developed are carefully field validated in schools and questions with appropriate correlation and validity are selected from to make up the final diploma examinations. Diploma examination marking sessions are held in January and June of each year with 225 to 250 senior high science teachers participating in the marking of examinations in Science, Physics, Chemistry and Biology (3 to 6 days). The diploma examination marking experience is viewed by teachers as a significant professional development opportunity.

A Decade of Curriculum Reform in Alberta

In 1984, Alberta Education undertook a massive review of secondary education in the province. A questionnaire was distributed to Alberta households and over 10 000 responses were received, recorded and analyzed. Many Albertans and groups of Albertans wrote letters and telephoned Alberta Education presenting their views. Representative students were consulted and a special advisory committee provided additional advice to the Minister of Education. In 1985, results and recommendations coming out of the Secondary Education Review (1984) were published in the policy report Secondary Education in Alberta (1985). The findings and recommendations in this report supported the principles and objective of the Government's White Paper: Proposals for an Industrial and Science Strategy for Albertans 1985–1990. This paper indicated education should encourage ideas of risk-taking, innovation and pursuit of excellence. The need to prepare youth to grapple with the very difficult problems facing society and to shape the future through their actions was expressed. The ideas expressed are reflected in the goals for secondary schooling and in the statements to guide future changes to programs and organization in secondary schools.

The Secondary Education Review (1984) in Alberta had been undertaken to determine the nature of curricular reform appropriate for the Grade 7 to 12 programs. The results of this review sparked a complete revamping of the secondary school curriculum, which was followed by the examination and revision of the elementary curriculum (Early Childhood Education and Grades 1 to 6). During the years 1985–1994, an active period of curricular reform followed with both core (required) and complementary (optional) program areas being reviewed and revised and several new programs, including the Science 10–20–30 program (Grades 10 to 12) and Career and Technology Studies (Grades 8 to 12), being developed.

Directions Established for Secondary Science Education in Alberta

Several factors influenced the senior high science curriculum development in Alberta. Secondary Education in Alberta (1985), the Alberta Education policy paper; Science for Every Student, Report 36 of the Science Council of Canada (1984); and Science for All Americans (1989), the American Association for the Advancement of Science report provided a major influence on the establishment of program goals and structure. The policy statement, Secondary Education in Alberta (1985) set the new program directions to emphasize the basic concepts and principles of science and their application in our world. Scientific literacy for all students, to be achieved through inclusion of consideration of the interactions among science, technology and society (STS), had emerged as a major program goal. The STS approach was to provide Alberta students with a more balanced science education, a goal that was supported by educators across Canada and around the world.

The eight recommendations of the Science for Every Student, Report 36 (Science Council of Canada, 1984) had the goal of "scientific literacy for all". These recommendations were:

Science Education for All
1. Guaranteeing science education in every elementary school.
2. Increasing the participation of young women in science education.
3. Challenging high achievers and science enthusiasts.

Redirecting Science Education
4. Presenting a more authentic view of science.
5. Emphasizing the science-technology-society connection.
6. Setting science education in a Canadian context.
7. Introducing technology education.

Monitoring Science Education
8. Ensuring quality in science education.

The Alberta Education Senior High Science Curriculum Development Project was launched in 1987 with intent to address all of the Science Council of Canada (SCC) recommendations to varying degrees, with the exception of goal 1, which applied specifically to the elementary school level. As explained previously, major importance was given to the emphasizing of the science–technology–society connections. The development of a new integrated science course, Science 10, as prerequisite for all the new academic science programs and an integrated science route (Science 20–30) as an option for students along with new biology, chemistry and physics routes was determined as appropriate. The inclusion of a new integrated science route, along with a strong STS connections component across the new curriculum, was determined to have the greatest potential to respond, not only to recommendation 5, but to all of the other recommendations, with the exception of recommendation 8. The other recommendations were to be addressed through careful development of the STS connection component in the curriculum and in the development or identification of the various resources to support the new curriculum. Sample STS connections that provided a good teaching and learning context for student development of the science knowledge (major concepts/sub-concepts), problem solving and decision-making skills and positive attitudes toward science and lifelong learning, were developed within the new science programs. A section of the Science 10 Course of Studies (Unit 1) is presented in Appendix G. This sample course of studies demonstrates the nature of the end product of this curriculum development process and includes the Senior High Science Vision Statement and all the other components common to the senior high science programs or courses of study previously described.

Another important consideration in the curriculum development was the establishment of clear expectations for students. Clear expression of the curriculum goals in terms of student outcomes was a major goal and strongly influenced the structure of the new curriculum. This was the first step in addressing recommendation 8. All program of studies goal statements are expressed in terms of the student and what the student is expected to do or accomplish. Considerable focus within the project was given to the development of sample evaluation and assessment items and instruments, including performance assessment items that focused on skills assessment. Assessment of the new STS curriculum component required considerable broadening of assessment and evaluation strategies. The development of diploma examinations for the new curriculum to address the broader curriculum goals directly addressed recommendation 8.

In addition to the STS connections component and a focus on student outcomes, there were strong constructivist undertones to the new curriculum. Students were to take more responsibility for their learning—they were to learn by doing and to be actively engaged in problem solving and decision-making activities. The development of thinking skills and science knowledge through the use of student relevant STS contexts was a means to have students connect what they were learning with their own experience. The introduction of the integrated science focus and the overarching themes of change, diversity, energy, equilibrium, matter and systems into all the new programs was to encourage student understanding of major principles of science that bridge discipline boundaries by providing a framework that they could use to construct and organize their science knowledge around. The inclusion of the learning cycle (Science 10 Course of Studies, Appendix G, p. 9) provided a strong constructivist model for student learning in a STS context.

The science curriculum changes in Alberta began at the junior high level (Grades 7 to 9), with the development and field validation and implementation of the program of studies (legally mandated curriculum document) and the custom developed student and teacher resources (1985–1988). Changes at the senior high level followed with new programs and resources being developed or identified, field validated and implemented (1987–1994). The final changes to the Alberta science curricula were completed with the provincial implementation of the new elementary level (Grades 1 to 6) curriculum in September 1996.

Curriculum Development and Implementation in Alberta

The Curriculum Standards Branch of Alberta Education, under the direction of the Minister of Education, develops and approves curriculum and identifies or develops, authorizes and makes available teaching and learning resources for teachers and students using these curricula. Having been part of the senior high science curriculum development and implementation process in the Curriculum Standards Branch over the last eight years, I have observed changes in the manner that curriculum is developed and implemented by Alberta Education. Most of these changes are linked to stringent budget restraint across government, the public cry for accountability in education, and the wider group of educational stakeholders wishing to participate in the curriculum development process, including the establishment of standards.

Traditionally, curriculum changes in Alberta began with a needs assessment and a proposal for change that was based upon the results of the needs assessment and current government policy. Once need and direction were established, Alberta Education would appoint a project manager, often a seconded teacher. This individual would work with a program advisory committee and one or more sub-committees of educators struck to develop the new program—the draft programs of studies for a particular program area.

An advisory committee, which included a representative from an Alberta post-secondary institution, the Alberta Teachers' Association, a school and/or school jurisdiction administrator, and Alberta Education officials, would consider all programs of study developing in a particular area, such as senior high science. Over a six-month to one-year period of time, the sub-committee(s) under the direction of the program manager would draft a program of studies and participate in the selection of appropriate resources for students and teachers. The program advisory committee would review, suggest revisions and approve the field validation draft of the program of studies and the resources recommended by the sub-committee(s). Field validation of the program and resources would follow, with revisions in response to the field validation being made and brought back to the advisory committee for approval, before going on to higher education officials and, finally, to the Minister of Education for formal and final approval. When the programs of studies and supporting basic student and teacher resources are approved by the Minister, the curriculum becomes legally mandated in Alberta.

The program development sub-committees were typically composed of eight to ten classroom teachers and one post-secondary educator experienced in the particular program. The Alberta Teachers' Association also was invited to appoint a representative and their representative was generally a classroom teacher experienced in the program area. Teachers were nominated to participate by their school jurisdictions and would be selected to represent a cross section of the Alberta teaching population. Alberta Education representatives and Alberta educators worked together on the actual curriculum development with Alberta Education facilitating the process, providing the resources and after the committee consultations, having the final say on curriculum development. Hence the term "centrally developed curriculum".

There has been no difficulty obtaining nominations for teachers to work on these curriculum development committees; teachers and school jurisdictions view such participation as a beneficial professional development activity and see the participating teacher as a potential professional development leader for their jurisdiction when the new curriculum being developed was implemented. Alberta Education paid all expenses for teacher participants, including travel, accommodation, subsistence and substitute teacher payment as the meetings would take teachers out of the classroom for several days during the school year, bringing them together in Edmonton to work on program development.

This process involved mainly Alberta Education and classroom educators. It was the model being used when the secondary science curriculum changes to the junior high science program began in 1986 and it continued, with some modifications, throughout the development of all the senior high science courses up until 1994. With the senior high science development, the model was stretched and modified in several, rather important ways as a result of external political pressure, changing economic circumstances in the province, and increased public awareness and participation in education generally, especially in the area of establishing standards and accountability. The consultation network was broadened substantially to include education stakeholders well beyond the traditional teacher group. A Minister's Advisory Committee on Senior High Science was established and it included representation from business and industry, professional associations (teachers, medical and engineering), post-secondary institutions, school jurisdictions, parent organizations and an interested member of the general public. Throughout the second round of program development, triggered by adverse reaction to the first round of program development, the developing programs of study in senior high science were widely distributed and feedback received from Alberta teachers, education administrators, professional organizations, parent groups, post-secondary institutions, non-government organizations and members of the public.

Currently, with the senior high science program curriculum development complete, this broader consultation during curriculum development and implementation has continued and been extended. The Career and Technology Studies (CTS) curriculum development that followed science used a more broadly consultative process and included members beyond the teaching community on the development committees. The CTS programs were innovative in approach and required new methods for development and resource provision. The movement to broader consultation and involvement beyond the teacher sector in curriculum development and implementation continues at Alberta Education to the present. Alberta Education now has an World Wide Web site on the Internet that has great potential to allow even a broader group of people to respond to draft curriculum during future curriculum development projects (Internet address: http://ednet.edc.gov.ab.ca).

Field Validation Process

When a new draft curriculum has been developed and appropriate student resources have been identified or custom developed, Alberta Education generally will conduct a field validation; a trial or pilot of the new curriculum and resources with teachers and students in schools. The teachers, students and administrators of the selected field validation schools provide written and verbal critiques of the curriculum and resources. Their comments are carefully considered, informing revisions to the developing curriculum and/or resources.

The selection of field validation school sites is an important process. The purpose of such a selection is to provide a representative sample of teachers and school environments from across Alberta. School jurisdictions are invited to nominate particular schools within their jurisdiction to participate. At the time of the call for field validation schools for the senior high science programs, there were approximately 181 school jurisdictions. In some cases, the schools and teachers within those schools nominated by their jurisdictions were consulted and eager about their possible participation. In other cases, school principals or teachers within the school were unaware of their nomination or aware and even opposed to involvement and yet were still nominated as the school jurisdiction or principal who deemed such participation desirable. Put more simply, some schools and teachers volunteered and others were "volunteered".

From the pool of nominations received, Alberta Education selects a representative sample for participation. In the case of the call for nominations for senior high science field validation, approximately 70 nominations were received from school jurisdictions, and from these, 35 schools from 29 school jurisdictions were selected. The selections were made to assure a balanced representation of:

- urban and rural schools
- public, separate and private schools
- school sizes (small, medium and large)
- teacher diversity—age, experience, gender.

When the selection process is complete, school jurisdictions are notified as to the acceptance of their nominated school(s). In the case of the senior high science field validation project, a school was required to participate for the full three-year project involving the field validation of Science 10 in **Year One**, followed by the validation of Science 20–30, Biology 20–30, Chemistry 20–30 and Physics 20–30 programs in **Year Two** and **Year Three**. The Alberta Education expectation, agreed to by the school jurisdiction, was that the science teachers at the accepted school(s) would implement the new programs and resources in their classrooms, provide ongoing feedback to Alberta Education allowing appropriate revisions to be made to the developing courses of study and resources, and that they participate fully in the teacher inservice program provided by Alberta Education.

What would be the advantages of participation for a school jurisdiction or school? Teachers within the participating schools would have direct professional input into the development of the programs of study and the custom-developed resources. They would participate with other field validation teachers from across the province in the inservice activities provided by Alberta Education. There was great potential for professional development of teachers at no cost to the school or school jurisdiction. Alberta Education would be providing participating schools with class sets of the new student texts for biology, chemistry and physics for use in the second and third years of field validation. Field validation teachers become an important source of professional leadership within the school jurisdiction, capable of assisting other teachers as they implement the new programs one year later. The stakes were high as all four of the new 30-level sciences were to be diploma examination subjects; subjects for which Alberta Education sets examinations, scores and reports results. A student's mark on the diploma examination accounts for 50% of their final course mark and the teacher-awarded mark accounts for 50%. In the third and final year of field validation, teachers would be involved with the field trials for the diploma examination questions and, thus, have first-hand knowledge and experience with how those examinations would be changing upon the introduction of the new curriculum. Again, this would be an advantage, easing the transition to the new curriculum and diploma examination expectations within the school and potentially within the school jurisdiction.

I have heard many teachers express the sentiment that since they are required to implement the new curriculum a year later anyway, why not get in on the ground floor—do it now and access the resources and support provided by Alberta Education. On the other hand, I also heard complaints from some teachers that their principal or jurisdiction simply announced that they would participate—that they had no choice in the matter in spite of feeling overloaded with commitments to other innovations within their schools.

Curriculum Implementation Model

Shortly after I joined Alberta Education, I became aware of the process of curriculum implementation that Alberta Education used. This model was referred to as the Cascade Model and had been used extensively in Alberta for a number of years. I came to understand that, although cost effective, this model was not very effective in supporting curriculum implementation. Alberta Education had direct responsibility for teacher inservice activities and implementation support for the field validation teachers during the field validation period, and provided basic student and teacher learning resources to field validation schools during this trial period. Generally, the new resources for new curricula would be field validated along with the new programs of study. The amount of inservice these teachers received was generally minimal, often just a one- or two-day orientation. It was expected that the field validation teachers, selected to be representatives from across the province, would form a nucleus of leadership for other teachers within their schools and jurisdictions and actively participate in providing professional development leadership to prepare other teachers to implement the new program.

In addition to working with the field validation teachers, Alberta Education representatives would generally provide one day information sessions in each of the five zones in the province. The Regional Offices of Alberta Education curriculum consultants shared the responsibility of presenting these information sessions with representatives from the central Curriculum Standards Branch. Information session participants were administrators, curricular supervisors and/or teachers who would attend and bring the information back to their various jurisdictions, providing leadership for inservice and implementation in their area. Information sessions were generally held at the Regional Offices of Alberta Education in each zone with Alberta Education representatives providing information and packages on program directions, suggested teaching and evaluation strategies, and recommended resources. Sample activities for the new courses were set up and teachers worked through discussing them and offering suggestions for improvement and assessment. These sessions ended with an extended question, answer and discussion period.

Alberta Education took the position that teacher inservice was part of the professional development of teachers. They took no direct responsibility for the professional development of teachers, even of those teachers that were required to implement the new curricula once it was developed, field validated and provincially implemented. The school jurisdictions, the post-secondary institutions and the Alberta Teachers' Association were seen as having major responsibilities in this area and the teachers themselves were viewed as having the professional obligation of keeping current with the new curricular initiatives.

Alberta Education provided funding to assist school jurisdictions during these years of rapid curriculum change in many secondary school subject areas. The Secondary Education Implementation Credit Allocation Grant (SEICAG) had two components:

- a per pupil grant of approximately $7 given to jurisdictions to be used for teacher professional development to assist in the implementation of all new programs
- a $14 per pupil credit at the Learning Resources Distributing Centre to be applied to the purchase of new student resources required for the various new programs being implemented at the secondary level.

The SEICAG was not a huge amount of money, but it did provide school jurisdictions with some help in defraying the costs of the many new textbooks the new curriculum demanded and for professional development activities at the school jurisdiction level.

The Science 14–24 Implementation Experience

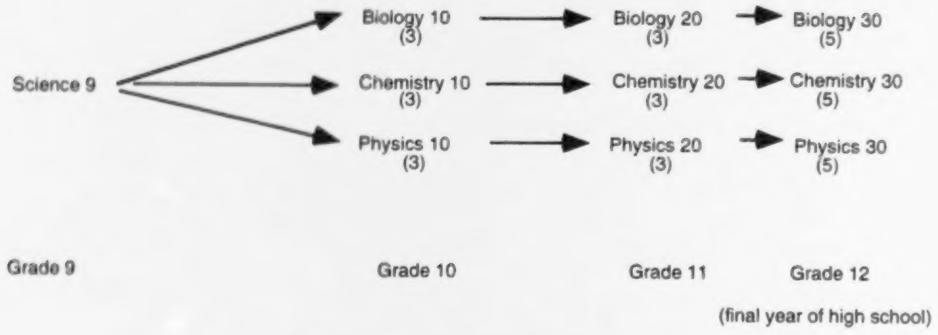
Science 14–24 is a remedial science program for high school students (Grades 10–12) who have experienced considerable difficulty in junior high science and mathematics. It was the first of the new senior high school science courses to be developed and was a much smaller project than the one project described in this study. Approximately 6000 Alberta students would be enrolled in this program per year compared with approximately 30 000 who would be taking the Science 10 course that leads to the various 20- and 30-level science courses. During the 1987–88 school year I was responsible for the field validation, custom resource development and inservice and implementation support for the ten field validation teachers of the new Science 14–24 program that was provincially implemented in September 1988. The resources available for this project were much less than those available for the later senior high science program implementation. Only ten teachers participated in the two-year field validation. In **Year One**, a two-day orientation was provided before the Science 14 field validation began. A one-day session was held halfway through the school year. In **Year Two**, a one-day session was held, again halfway through the school year. The focus of the one-day sessions was information sharing to facilitate program and resource development more than teacher inservice, although, the sharing of experiences that occurred between the assembled teachers was valuable to them.

A High Profile Curriculum Development Begins

The process of curriculum development at the senior high school level (Grades 10–12) began in 1987 with the appointment of a program manager and the formation of teacher curriculum committees for each program area; Science 10–20–30, Biology 20–30, Chemistry 20–30 and Physics 20–30. The senior high science program development was highly controversial, involved two, one-year delays of implementation, major redrafting of originally proposed curriculum and numerous rounds of revisions to the various programs. As a result, the original planned implementation date of September 1989 was moved first to September 1990 and, finally, to September 1991. A complex saga of events associated with the proposed changes, stakeholder reactions to such changes and the responses of Alberta Education, unfolded (Blades, 1994). The controversy and conflict surrounding this program development, particularly that of the new Science 10–20–30 program, resulted in the curriculum change process opening up well beyond the traditional educator group Alberta Education previously consulted during times of centralized curriculum development. An unprecedented amount of consultation with a wide variety of stakeholders in education, not only teachers, but representatives of professional associations, business and industry, post-secondary institutions and the general public, resulted.

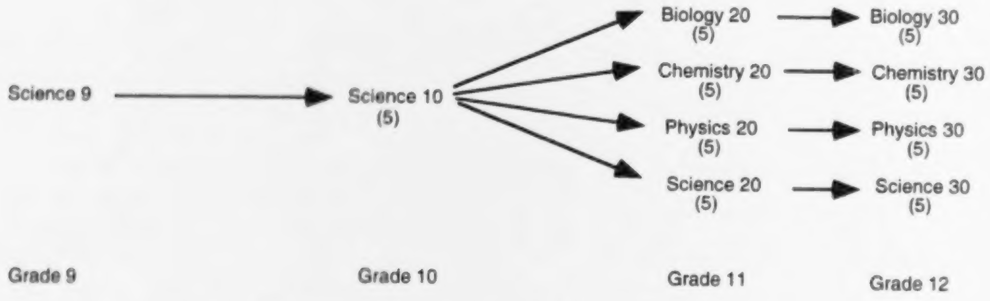
The proposed changes were substantial and called for the rearrangement to the whole framework of senior high science programs. Figures 2.2 and 2.3 present a comparison of the framework of the previous high school science program to the new senior high science program. The introduction of an integrated science stream and the explicit science, technology and society component in all program areas was also a major change. Previously, students had been offered a choice of biology, chemistry and physics at the Grade 10 level. Now, that choice would be delayed a year and most students would take the new integrated science, technology and society focused course, Science 10. Science 10 is the prerequisite to all the new 20-level (Grade 11) courses; Biology 20, Chemistry 20, Physics 20 and the new integrated science choice, Science 20, and the terminating 30-level (Grade 12) courses that follow.

Figure 2.2: **Previous Senior High Science Program Framework**


Science 9
Biology 10 (3)
Chemistry 10 (3)
Physics 10 (3)
Biology 20 (3)
Chemistry 20 (3)
Physics 20 (3)
Biology 30 (5)
Chemistry 30 (5)
Physics 30 (5)
Grade 9
Grade 10
Grade 11
Grade 12
(final year of high school)

*(3) denotes a half-course offered for 62.5 hours and 3 credits
*(5) denotes a full-course offered for 125 hours and 5 credits

Figure 2.3: New Senior High Science Program Framework


Science 9
Science 10 (5)
Biology 20 (5)
Chemistry 20 (5)
Physics 20 (5)
Science 20 (5)
Biology 30 (5)
Chemistry 30 (5)
Physics 30 (5)
Science 30 (5)
Grade 9
Grade 10
Grade 11
Grade 12

*(3) denotes a half-course offered for 62.5 hours and 3 credits
*(5) denotes a full-course offered for 125 hours and 5 credits

University academics, educators, parents, professional associations and other members of the public had joined the controversy surrounding these changes fearing the "watering down" of the science program and the eroding of the more traditional discipline sciences. In response, the Minister of Education made the decision to abandon the original drafts of the controversial program and begin again while retaining the original program framework with Science 10 leading to all the other science choices at the Grade 11 and Grade 12 levels. He established a special, broadly, representative committee that included many of the most strident objectors to the original programs. This committee was to consider and advise Alberta Education as the new program developed. Science 10–20–30 would remain an integrated and STS focused program, but would be redrafted and through extensive consultation and approval of this special committee, gain general acceptance by the teachers and the community at large.

In early 1991, with the field validation of the new programs on the horizon, Alberta Education had invested significant resources in the development of these new programs; much more than had been anticipated. Two rounds of establishing and working with first teacher advisory committees and then committees with more extended representation for each program area—Science 10–20–30, Biology 20–30, Chemistry 20–30 and Physics 20–30 had been completed. The Minister's Advisory committee on senior high science had met several times, and monitored and approved the development of the field validation draft of the program. Several rounds of consultation by mail on various versions of the program of studies for these courses had been completed with not only teachers but with an extended network of representatives from post–secondary institutions, business and industry, professional associations, parent organizations and interested members of the public. The five Curriculum Standards Branch Science Team members, the program manager and a consultant for each program (science, biology, chemistry and physics), who were directly responsible for the new program development, toured the province, hearing directly from teachers advice regarding the field validation drafts of the programs and specifics regarding their perceived needs for support during the implementation phase. The Science Team had at this point been working full-time for an additional two years beyond what had originally been expected. A contract between Alberta Education and Gage Educational Publishers for the custom development of the student texts and teacher's guides for the Science 10–20–30 program had experienced costly rounds of revision and delays as a result of the controversy.

The high public profile of this program, and the considerable resources that had already been expended on the project, provided strong political pressure on Alberta Education; pressure for the second round of development to be very carefully considered and broadly consultative, and for the implementation of the new senior high science program to succeed; for the program to be accepted by the teachers, students and the public as the best possible program for Alberta students.

The political pressure for the senior high science program development to succeed, in turn, resulted in considerably more Alberta Education resources being allocated to the teacher inservice component of the project than to previous curriculum field validation projects. To this point, Alberta Education had never embarked upon such an extensive field validation and inservice component within a curriculum development project. Over the three years of this project, approximately 170 teachers, 4000 students and 35 schools from 29 school jurisdictions across Alberta participated. A total of 14 days of formal teacher inservice were provided by Alberta Education over the three years.

Fiscal Restraint Across Government

As I began this project in 1991, the era of severe fiscal restraint in government had not yet come into full effect in Alberta. Over the three-year project, significant budget cutbacks in education were experienced and these placed tighter limits than originally expected upon the possibilities for inservice and implementation support. I planned the inservice activities carefully to assure that Alberta Education would be providing the maximum inservice experience for the minimum cost while operating within government policies and practices. Some changes that resulted were restrictions on travel that eliminated the possibility of continuing visits to the field validation schools in the second and third years of validation and the cancellation of the planned one–day call back sessions of field validation teachers at the mid–point (January) of field validation Years Two and Three. Transportation for teachers to the three major inservice activity sites over the three years was a major expense as teachers attending came from areas widely dispersed across

Alberta. The Senior High Science Field Validation Plan document presented in Appendix D provides information on the project process, a project schedule and a map showing locations of the field test school sites in the province.

Human Resources

The Alberta Education Curriculum Standards Branch Science Team—the senior high science program manager (project position—originally seconded classroom teacher), six classroom educators (including myself) seconded or contracted, and one permanent government employee—was available to provide consultation and assistance in planning and implementation of inservice and support activities and identification of resources for teachers and students. Two of these people worked directly with me on resource identification, teacher resource manual development, and inservice planning and implementation. The four Alberta Education, Student Evaluation Branch diploma examination managers for Science 30, Biology 30, Chemistry 30 and Physics 30 worked closely with the Curriculum Standards Branch Science Team on various aspects of the program development, and on inservice activities involving assessment and evaluation. Their major involvement was to lead the development and field validation of the first new diploma examinations within the field validation project.

Secretarial and Clerical support available to the science team included two secretaries working directly with us, and access to a desktop publishing secretarial pool and editorial services as required.

Field validation teachers and administrators were major resource people for this project. They played an important leadership role in inservice activities for the other field validation teachers in **Year Two** and **Year Three** and for the information sessions for those teachers not involved in the field validation project.

A Post–modern Examination of the Possibility of Curriculum Change

Blades (1994) takes a post–modern approach to examine the complex power relationships associated with the development of the new Science 10–20–30 program in Alberta. He contends that this curriculum development began with great possibility for change in science education and that over the development period that potential was diminished through various procedures of power to the point of offering little, if any, hope of meaningful change. The Alberta Science 10 course is the academic science course most Grade 10 students in Alberta will experience as it is the prerequisite to all academic Grade 11 science courses (Figure 2.3). The original September 1988 draft of the Science 10 program unit descriptions (Blades, 1994, p. 47) put forth an innovative, and totally integrated, STS course that was eventually abandoned due to political factors in favour of a traditional discipline science unit framework reflected in the August 1990 draft (Blades, 1994, p. 81). The prevailing framework was the result of major redirection and redrafting of the program. This reframing is viewed by Blades as severely limiting the possibility for meaningful change in the Alberta senior high science curriculum.

The documents, events, circumstances and personal perceptions of various participants in the Science 10–20–30 curriculum development process are traced by Blades within the broader context of the history of North American science education. His dissertation discourse argues that the philosopher Michel Foucault's (1926-1984) concept of power provides a way to understand the hope and possibility for curriculum change. Blades interpretation of the procedures of power in this particular science curriculum is based upon the work of Michel Foucault (Foucault, 1982). Blades personal story of struggle with change, and possibilities for change, in science education as a teacher, as an Alberta Education curriculum contractor, as a basic student text and teacher guide author, and as a researcher revealing his dilemmas, and even despair, are skillfully interwoven within the discourse termed the "Great Conversation". The carefully documented outline of the preliminary curriculum development process, coupled with the detail provided in a rich allegory of the same process, causes the reader to come to grips with the difficulty, and perhaps even impossibility of meaningful change, in curriculum given the barriers of Ge–stell, en–framing and the procedures of power. Blades provides a very broad and multilayered post–modern examination of the curriculum document evolution as related to procedures of power.

The Story Continues

Blades is the first educational researcher to examine the recent Alberta senior high science curriculum reform. Blades was a participant in the change process he examined.

I am the second researcher. I had six years of participation in the senior high science program development and implementation project as a contracted educator working with the Alberta Education, Curriculum Standards Branch Science Team. I am an experienced secondary teacher with a science specialty. My major task over the three-year project was to plan and implement appropriate inservice activities and provide supporting resources and strategies for the 170 senior high science teachers involved over the duration of this project. It is the story of the inservice and implementation support for teachers field validating and implementing the new senior high science programs that I wish to tell.

I will continue the story Blades began. The development of the field validation draft of the curricular document, although a important first step, was the beginning of the inservice and implementation story. This study is about the power of practicing professional teachers, provided with resources, support and inservice opportunities, implementing a major curriculum change in a manner that I believe has resulted in the meaningful changes at the classroom level.

CHAPTER 3

SURVEY OF SELECTED LITERATURE

Top–Down Curriculum Implementation: A Challenge to the Inservice Planner

Common (1988) discusses the challenges of implementation of a centrally developed curriculum. The contemporary approach to implementation of innovations in education is "top–down" in nature. In school systems, theories or innovations are developed by individuals in superordinate positions who have the power to intervene in the working of those who are their subordinates, namely the teachers. The "innovators" are either experts in the issue at hand or are able to secure the service of experts. Subordinates (teachers, students) are considered to be non–experts and thus the "users" or consumers of the prescriptions of the experts.

The theoretical model involved in such an approach is illustrated by the Research, Development and Diffusion Model of Clark and Guba (1965). When this model, which has its roots in non–educational fields of practical application such as drug production, engineering and agriculture, is applied to education, problems are encountered, particularly in the later stages of diffusion and adoption of the products. A process–product model breaks down and many centrally developed curriculum changes (or other educational innovations) have been and continue to be unsuccessful, not because the innovations themselves are not good, but because of the underlying power struggle between the "curriculum experts" and teachers. In this model, teachers are treated as technicians, with teaching being viewed as a second–order applied activity. Both government officials and school administrators expect teachers will accept and use centrally developed curriculum given the bureaucratic nature of the school hierarchy. It is assumed the teachers have a primary need for job security and that they will "fall in line" to avoid negative sanctions and earn the rewards of the organization. The formal trappings of curriculum implementation, such as publicity, inservice and program evaluations, can give the appearance that teachers are under considerable control and a specific implementation is unfolding as it should, in the manner planned by the "experts". The underlying conflict lies in how the curriculum experts perceive the teachers mandate and how teachers themselves perceive their mandate.

Teachers hold an opposing view. They see themselves as major actors and defenders of the status quo who have considerable influence over students and to a lesser degree parents of students. They are the very busy front line curriculum experts, dealing with the day to day details and challenges of how to best deliver the curriculum to students. They do not view themselves as passive or submissive nor as technicians.

They value continuity and feel a stable environment is essential to effective teaching. Teachers hold fairly unchanging bodies of ideas about how and what to teach students and cling tenaciously to their status quo, being its staunchest defender. Curricular innovations implemented top–down destabalize their environment. Such changes are generally not viewed favourably.

> Implementation of new curriculum is about power. And problems in the implementation of curriculum reform are rooted in misconceptions about power centres in education systems. (Common, 1988, p.4)

Common (1988) believes that teachers have the power to prevail in such struggles due to the nature of the school organization and the loosely coupled way in which schools are normally governed.

She calls administrators to support the "loosely coupled" nature of our education system, resisting the further tightening of governance, and provides suggestions for doing so. Such support allows an environment in which the professional character of teachers can flourish, preventing the creation of a workplace for technicians. In order for such nurturing of professionalism in teachers an understanding of what being a professional is, how teachers are professional, how they must be accountable to stakeholders, and how they can be judged fairly and equitably is essential. Administrators are charged with creating an organizational climate that empowers teachers to a professional manner of practice. Professional empowerment of teachers is the most proper and clearly the most effective way to achieving excellence in curriculum and education.

This study is a detailed examination of the inservice (diffusion) phase of a centrally developed curriculum, and provides a springboard for reflection on the whole process. Questions regarding the Alberta Education development and implementation of the new senior high science programs that arose after I read Common's paper were:

- Has the unprecedented degree of consultation with stakeholders, especially with teachers, during this curriculum development been enough from the teachers' perspective? Is any amount of consultation enough if the impetus for change is from Alberta Education and education stakeholders other than teachers?
- If curriculum is not centrally developed, how would curriculum change be initiated? Who would be responsible for curriculum change? Would teachers develop new directions in curriculum through a grass roots initiative? Would curriculum ever change given teachers tendency to favour stability and resist change?
- How was the struggle for control, the conflict between the curriculum experts and the teachers, handled in the inservice and implementation phase of my study case?
- Are there other models of curriculum implementation that have proved effective? If so, why is the "top–down" model still so widely followed when it's history of success is so bad?
- School administrators play an important role in the implementation of new curricula. From our experience in the senior high science implementation, what role have administrators played and how could Alberta Education collaborate more closely with them during times of curriculum change?
- Who has responsibility for teacher professional development—the individual teacher, teachers' professional associations, administrators, school jurisdictions, post–secondary faculties of education, Alberta Education? Should it be a partnership and, if so, how do the responsibilities break out? Is there an underlying assumption that teachers as a group are professional in their attitudes and practices? How do we know this?
- Are the underlying power conflicts between Alberta Education, the ATA, school jurisdictions post–secondary institutions and groups of teachers collectively eroding the possibility of

positive change in practice and teachers' professional development? Do teachers become so embroiled in conflict and feel so lacking in empowerment that they give up on professional development related to curriculum change issues?

- Education budgets are being cut, teachers are often overloaded with tasks not directly related to educating students. Many students, for a variety of reasons, arrive at school ill prepared to learn. Is there any hope of teachers who are feeling extremely hopeless, angry or perhaps even numb maintaining a professional attitude toward the implementation of the new science curriculum?

Common clearly defines the challenge of conflict in "top–down" implementations of curriculum change. Successful implementation of new curriculum is a challenge, with the planning and implementation of effective inservice activities playing a critical role.

Teachers' Functional Paradigms

Crocker (1983) builds on Kuhn and Imershein's conceptions of "paradigm" and becomes the originator of the proposal to reformulate the concept of paradigm, applying it to the study of teaching. He proposes that research on teaching be redirected from a simple description of classroom practice toward identification of what may be called the "functional paradigms" of teaching. Crocker views the paradigm as the uniting features of a community of teacher practitioners rather than of the community of scholars who study these practitioners. He assumes that teachers are similar to other groups of scholars or practitioners and that they have common goals, problems and routines that make up a "functional paradigm". Thus, the term "functional paradigm" suggests that the common characteristics holding a community of practitioners together are likely centred on practical matters (Crocker, 1983, p. 354). Lantz and Kass (1987) summarize research by presenting and discussing models for the functional paradigm of high school chemistry teachers. I use their work as a foundation for the development of the models I present in my closing chapter—models that relate to the importance of considering teachers' functional paradigms in the planning of teacher inservice activity.

Crocker (1983) contends that such paradigms, once identified, would help explain classroom functioning. The notion of a functional paradigm of teachers implies that research ought to depart from the conventional focus on differences between teachers' practice and focus instead on their commonalties. Crocker's three research subjects were science teachers being challenged to change their classroom practice. Within the research examples, he indicates and reinforces the point that there is often a lot of contrast between teachers' functional paradigms and the paradigms of curriculum developers or teacher educators. As a result, the curriculum as written or methodology as presented can be significantly different than the curriculum as implemented by the classroom teacher.

The context of implementation of innovation, the call for teachers to change their practice in some manner, presents a golden opportunity, a "strategic site" for the study of teachers functional paradigms. Interesting patterns of teacher beliefs emerged from the three research studies described. These patterns included concern with content coverage, placing importance on clarity of curriculum mandate, importance placed upon classroom management, holding the view that students must be subject to direct instruction and that many students could never learn without direct teacher intervention, showing concern for slow learning students, observations that the teacher does most of the talking with the solicit–response–react cycle evident and that students cast themselves in the role of subordinate to the teacher.

> Change in teacher practice is very difficult. Crocker points out that the commonly held belief is that teachers, in fact, are little influenced by teacher education, and are more likely to teach as they themselves were taught (Crocker, 1983, p. 359).

To make any substantive change in teacher paradigms takes intensive effort. Teacher inservice activity during major curriculum change is an opportunity for the experts to make that intensive effort but it takes an equally intensive effort on the part of the teachers before any change can be realized.

Crocker provides the foundation for the concept of a "teachers' functional paradigm", a very useful construct in my study that involves the planning and of implementing of, inservice activities to encourage teacher change during a time of significant curriculum change. Crocker's research findings supporting the notion of teachers' functional paradigms are similar to my findings over the three years inservice activity planning and implementation with Alberta senior high science field validation teachers.

Teacher Practical Knowledge: Important Ingredient in the Implementation of Change

Dufee and Aikenhead (1992) present a heuristic for teacher practical knowledge. The construct of teacher practical knowledge is explained as a holistic, interactive, and organic set of ideas. The heuristic was developed in an attempt to clarify a researchable functional paradigm (Connelly & Clandinin, 1985; Common, 1988) by incorporating a wide range of elements and processes. They present the heuristic as a tool, a "clue structure" for analyzing qualitative data, a research process developed by Roberts & Russell (1975).

The heuristic implies three components of teacher practical knowledge:

- teachers' past experiences
- teachers' current teaching situations
- teachers' visions of how the teaching situations should be.

Past Experiences

The past experiences of teachers include their life experiences that extend well beyond formal education and provide important lessons about human relationships and behaviour. The research done on teachers' practical knowledge indicates that three types of past experience mold our ways of knowing—education, teaching and life experience all have important effects (Connelly & Clandinin, 1995; Roberts & Chastko, 1990). Throughout their lives, teachers are developing and refining their beliefs, values and rules of practice in a very individual manner and these elements are the important components of their functional paradigm of teaching.

Current Teaching Situation

A teacher's current teaching situation has an number of variables that include the expectations of the community, students, administration and colleagues and the mandated curriculum. The resources available to the teacher from both inside and outside of the school also are important considerations. All these factors play a role in the instructional decisions a teacher makes.

Vision of the Ideal

This vision is a mental picture a teacher holds of how the teaching situation should be. It provides the framework from which teachers can make adjustments that bring together the rules and principles of practice and the teacher's beliefs and values, with the demands of the current situation.

Three Important Considerations for Inservice Planning

In the planning and implementing inservice activities for the Alberta senior high science teachers involved in the field validation of the new curriculum, I found that consideration of all three of these elements was very important. The Science Team as the planning group, all experienced classroom teachers, were aware of the common features of teachers' past experiences having had those experiences themselves. We all made an effort to keep in touch with the current teaching situations in the various Alberta schools offering high school programs. The current common vision of what was quality teaching practice were also discussed and determined to be quite traditional although pockets of teaching practice that were more visionary were identified. The Senior High Science Program Vision Statement (Appendix G) was developed with a mind to how the teaching situation should be. Conveying that Vision to teachers in a manner that would result in action to implement it in Alberta classrooms was the challenge that the Science Team faced—first with the field validation project, including the inservice activities, and then with the rest of the teachers in the province as the new curriculum was implemented provincially. Olson (1982) points out that most decisions for teacher action will reflect the vision of the ideal teaching situation that they hold. When the decisions for action do not closely reflect this vision, painful dilemmas confront the teacher. The greater the misalignment, the more painful the dilemma becomes. As the Vision for the new senior high science program represented a considerable departure from the previous more traditional curriculum and called for substantive changes in teaching practice, considerable discomfort was anticipated among the teachers involved.

Comparing Paradigms

When considering teacher practical knowledge in a past/present manner, the heuristic allows consideration of "paradigm shifts" in classroom practice. As an example the implementation of an STS science course involves a paradigm shift in classroom practice. Teachers' reflections on practice tend to compare "past experiences" (old program) with "current teaching situations" (new program). Such a teacher paradigm shift was being called for with the implementation of the new Alberta Senior High School Science Curriculum.

The Duffee and Aikenhead (1992) study involved in–depth interviews with 6 male senior high science teachers in an urban centre in Saskatchewan at the time a new STS focused science course was being implemented at the Grade 10 level. The interviews focused on the evaluation techniques being used to assess students' knowledge of science, the reasons within the framework of teacher practical knowledge for selecting the particular evaluation practices they used, and their reasons for including or excluding evaluation of the three STS content areas found in the new curriculum. The three areas of STS were the nature of science, the STS interconnections, and the values that underlie science. The framework used to present and analyze the interview data was provided by the heuristic and included consideration of past experiences and influences and the current teaching situation.

Duffee and Aikenhead draw from and build upon previous research, giving it a new and exciting twist. The heuristic developed offered a model of how I could approach analyzing my data and organizing the presentation of ideas in my study. I found in reading the article that much of the description of the heuristic rang true with my past experiences as a teacher, my current situation working as an inservice and implementation consultant, and my vision of the way things should be in regards to inservice and implementation of new curriculum.

A particularly powerful paragraph in the closing implications section was (my bolding):

> The results of the present study have implications to employers and teacher educators. When recruiting teachers to instruct new types of science courses (such as STS science), one should consider the candidate's background with respect to his or her non–science orientation. The science teacher who can most easily adapt to an STS type of course will *not* likely be the teacher who has a narrow orientation toward pure science. **In–service programs must provide teachers with a dramatically memorable experience in order for the programs to compete with the deep–rooted, well–established elements of teacher practical knowledge.** A dramatic experience may entail a professional development, four–week internship with a "master" teacher. (Duffee & Aikenhead, 1992, p. 504)

The Alberta senior high science field validation inservice project afforded an ideal opportunity to provide such "dramatically memorable" experiences for teachers.

Student Evaluation: An Important Consideration

Crocker, Dodd, Banfield, and Bannister (1988) emphasize that when teachers are considering the implementation of new curriculum, the issue of student evaluation is a top priority and an important component of teachers' functional paradigms. In the implementation and inservice for the new science programs in Alberta, I certainly found this to be the case. In this study, I will discuss this important issue based upon my experience working with teachers in the inservice project.

Teachers and the Change Process: A Constructivist Focus Supported by Reflective Practice

The teacher is the key to educational change in the classroom. In this era of educational reform teachers are challenged to implement various new science curricula; curricula which call for a broader definition of science teaching and learning. One promising area of research that addresses these and related issues is constuctivist research. Can teachers successfully come to understand and embrace a constructivist model as a broader theoretical framework to support recent science curriculum reforms? Will they find the conviction and energy to implement curriculum changes using a constructivist model; changes that call for a greater degree of personal responsibility in professional practice through increased metacognition and reflective practice? Can they successfully encourage their students to do the same? For most teachers, implementing new science curricula initiatives will call for considerable change in practice; a shift in their functional paradigms (Connelly & Clandinin, 1985). Although research that is directly related to the challenge of change in teacher practice is often constructivist in theory and includes emphasis on reflective practice, one study which is not constructivist yet considers reflective practice is considered. In addition, two grounded theory studies in the area will be discussed.

Prawat (1992) describes teachers' views of teaching and learning as strongly influencing their classroom practice. The dominant prevailing view of teacher practice can be described as a "transmission" approach to teaching and an "adsorptionist" approach to learning. This traditional view places students in a passive and receptive mode—they listen, read and write to accumulate the knowledge their teachers are providing. Such a view is a significant barrier to changes in teacher practice.

Questions that arise in my mind upon consideration of Prawat's article follow. These questions are all considered in the closing chapter of this study, Chapter 6.

- How does such a change process occur for individual teachers—is it an evolutionary or revolutionary process?
- How can the functional paradigm model provide a framework useful in researching the phenomena of change in teacher practice?
- How does reflective practice relate to the constructivist framework within such programs?
- What type of preservice or inservice program designs would facilitate the process of change for teachers?

Beginning with two recent articles, one by Cheung & Taylor (UK) and the other by R. S. Prawat (USA), current science curriculum reforms will be linked to constructivist theory and in that context the challenge of change facing educators and researchers will be defined.

Constructivist Based Curriculum Implementations: Views from the UK, USA and Australia

Cheung & Taylor (1991) strongly advocate a constructivist approach, developing and proposing a constructivist model as a theoretical foundation to the new national science curriculum being implemented in England and Wales. In the early 1980s, the Assessment Performance Unit (APU) viewed pupils as problem–solving scientists who used science concepts and process skills in investigative learning situations. Pupils are viewed as active problem solvers who are continuously involved in inquiry, speculation, testing and construction of their own knowledge. The research associated with this project points to the close interplay of conceptual and procedural knowledge and such interrelationships are reflected in the design of the English and Welsh national science curriculum.

They propose that given that science knowledge has to be both personally and socially constructed, the challenge to constructivist teachers of science is to "cross the Rubicon" from individual personally constructed knowledge to consider as well socially justified and publicly mediated knowledge. Driver (1987), who endorsed the same view, has described the key features of the constructivist approach used in the Children's Learning in Science Project (CLISP) as a socialization process where the science curriculum is viewed as a set of experiences from which learners construct a view closer to a scientists' view rather than just what is to be learned. The teacher becomes a mediator between the scientist's knowledge and the children's understandings acting as a diagnostician of student thinking. The teacher must at the same time carry a mental conceptual map that allows the selection of appropriate learning activities to be suggested and meanings to be negotiated.

Prawat (1992) puts forth a challenge from the USA to the teaching profession.

> Teachers are viewed as important agents of change in the reform effort currently under way in education and thus are expected to play a key role in changing schools and classrooms. Paradoxically, however, teachers are also viewed as major obstacles to change because of their adherence to outmoded forms of instruction that emphasize factual and procedural knowledge at the expense of deeper levels of understanding. New constructivist approaches to teaching and learning, which many reformers advocate, are inconsistent with much of what teachers believe—a problem that may be overcome if teachers are willing to rethink their views on a number of issues. (Prawat, 1992, p. 354)

Prawat explains that an idea-oriented curriculum is more difficult for teachers. More experimentation and self-reflection are called for with teachers having to decide which ideas from a discipline to emphasize and how to put those ideas into real-life contexts. In doing so, they must draw upon many sources of knowledge balancing what is important for students to know from a discipline with what students are best suited to learn and what they are best suited to teach. In such a constructivist approach all these variables must be integrated. The constructivist approach carries more risk for students and teachers than the traditional transmission approach. He believes the benefits are worth the risk.

Four major beliefs teachers hold that act against a paradigm shift from traditional teaching approaches to constructivist practice are identified by Prawat. These beliefs, summarized below, are argued to underlie and legitimize the widely held transmission views of teaching and absorptionist view of learning.

- The dichotomous view of the learner and of the curriculum, instead of viewing them as interactive, as "two limits which define the same process". Teachers tend to focus on packaging and delivery of content, instead of the more substantive issues of knowledge selection and construction.
- Student interest and involvement (i.e. "hands–on activities") are both a necessary and sufficient condition for worthwhile learning.
- The long–standing distinction between comprehension and application, with two misleading notions: that learning is hierarchical, and that generalization leads to transfer.
- Curriculum is a fixed agenda, consisting of well–ordered content mastered according to predetermined criteria.

Prawat points out that excellence in teaching is often judged on the teacher's ability to manage curriculum, to run activities, and to organize students. A constructivist model of excellence in teaching would envision the classroom as a centre of intellectual inquiry where teachers and students engage in the in-depth exploration of important ideas from the different subject matter areas. He concludes his article with a suggested framework for encouraging the change in teachers which he feels is essential if a constructivist curriculum in science is to be successfully implemented.

Creation of a learning environment, such as Prawat describes, would certainly be supportive of the directions of the new senior high science curriculum in Alberta. As an inservice planner this was also the type of environment I wanted to create and model at the inservice sessions—an environment that would promote collegial interaction and exploration regarding the new curriculum among teachers from the three different disciplines of science and from the diversity of schools across Alberta.

> In moving toward a constructivist approach to teaching, teachers will need to attend to their own conceptual change at least as much as they attend to this process in their students. This will not be easy, and it is unlikely to occur without wholesale restructuring or reworking of the workplace. If teachers are to rethink teaching and learning along the lines discussed in this article, they must have the opportunity to participate in a learning community with other teachers and educators similar to the one they are trying to provide for their students. (Prawat, 1992, p. 389)

Prawat indicates that constructivism is relatively new on the educational scene and that many of its implications are yet to spelled out. Constructivist research tends to fall into two camps; research into learning or teaching. Constructivist views of teaching are much less well developed than constructivist views of learning. Researchers in the two domains are researching somewhat different areas. Learning theories tend to be descriptive while theories of instruction tend to be prescriptive. As a result, they do not directly inform one another.

Cobb (1988) cautions:

> Although constructivist theory is attractive when the issue of learning is considered, deep–rooted problems arise when attempts are made to apply it to instruction. (Cobb, 1988, p.87)

Prawat points out that most of the problems associated with implementing a constructivist approach to teaching could be overcome if teachers were willing to rethink not only what it means to know subject matter, but also what it takes to foster this sort of understanding in students. This is a tall order. Such change is unlikely to occur without a good deal of discussion and reflection on the part of teachers. Identifying what is problematic about existing beliefs, however, is an important first step in the change process.

The inservice activity planning for the Alberta senior high science field validation project had to address the issues raised by Cobb. It was a constructivist approach to teaching and learning that would best apply as teachers implemented the directions of the new curriculum in the classroom. The inservice activities had to effectively provide for the extensive discussion and reflection on the part of the teachers—a process resulting in the identification of the differences between what the teachers currently held as their functional paradigm for science teaching and the Senior High Science Program Vision Statement (Appendix G) for the new curriculum. The Year One inservice activities were the first step. Over the three years of the project the inservice activities, the classroom experiences of the teachers, and their many other experiences within the project all had great potential to result in changes in their existing belief structures—changes providing for better alignment of their paradigms with the Vision.

The Australian Perspective: Theory and Practice Linked Through Action Research

The Australian group out of Monash University and the University of Melbourne are extremely active and prolific collaborative action researchers. The research team included J. R. Baird, P. J. Fensham, M. Gill, R. F. Gunstone, I. J. Mitchell, J. R. Northfield, M. Slattery and R. T. White, along with several others all of whom were constructivists. Some members have been involved for over 10 years in this action research study addressing the teaching and learning of science as a new constructivist curriculum was being implemented in the state of Victoria (VCE). Various members of this group have authored the following four evaluative documents that report results of the research done on the implementation of a new Victoria state science curriculum.

Responding to the Challenge: An Evaluation of the VCE Pilot Program (1989)
Meeting the Challenge: An Evaluation of the VCE Pilot Program after Two Years (1991)
Understanding the Challenge: An Evaluation of the VCE Implementation after Three Years (1992)
The Challenge Continues: An Evaluation of the VCE Implementation after Four Years (1993)

This group's research involves the four recursive elements of action research design: planning, acting, observing and reflecting. They propose a constructivist approach to teaching and learning that they believe has great potential for improving education by changing educational practice through collaborative action and reflection on both process and practice.

The action research designs used by this group aim to establish self–sustaining, self–critical communities of practicing science educators and researchers by providing opportunity for them to theorize about their practice, to put their ideas to the test and to reflect in a variety of manners including personal journals. The designs generally involve groups of collaborators, usually researcher(s), instructor(s) and students, which provide for a triangulation of perceptions as a validity check. Initial planning by researchers is followed by cycles of planning involving all collaborators as the project evolves. Data is gathered through interviews, journals, observations and records of educational episodes, surveys and formal and informal discussions among the collaborators. The research of this group provides a reasoned justification for educational work (constructivist approaches in science teaching and learning) by providing the rational that what is being proposed has been developed, tested and critically examined and that will continue to be examined through a process of ongoing evaluation and revision of the initial premises and models. The assertions and more specific propositions within individual studies are presented as the context of the research in the introduction of the reports. These assertions and propositions are being tested and refined in an ongoing systematic, reflective and collaborative manner.

As an example of their work in the action research area, I will consider the collected papers of this group presented at a symposium held on Constructivist Perspectives on Individual Teacher Development at the annual meeting of the American Educational Research Association (AERA), San Francisco, March 1989. The four papers presented at the symposium were:

Baird, J. R. (1989). Intellectual and methodological imperatives for individual teacher development. Symposium, American Educational Research Association, AERA, San Francisco.

Gunston, R. F., Slattery, M., & Baird, J. R. (1989). Learning about learning to teach: A case study of preservice teacher education. Constructivist Perspectives on Individual Teacher Development, Collected Papers of Symposium, AERA, San Francisco.

Northfield, J. R. (1989). Construction of the practicum experience. in Symposium, American Educational Research Association,. AERA, San Francisco.

White, R. T., Baird, J. R., Mitchell, I. J., Fensham, P. J. & Gunstone, R. F. (1989) Teaching and Learning Science in Schools: An Exploration of Process, AERA, San Francisco.

As is common with this group, assertions are presented in the first paper (Baird, 1989) as a common framework for the research presented in the following three papers. The assertions below provided insight into the general nature and design of the action research commonly conducted by this group. Each of the assertions are followed with my descriptive summary of ideas they present that relate to each assertion. This description is presented in ***italics.***

1. Each of teaching and learning is a singular process of development of personal intellectual competence and performance.

   Tension between the specific and the general is acknowledged. Each teaching or learning episode is unique and efforts are directed to the identification of the episodes' uniqueness. On the other hand, certain aspects of particular teaching or learning episodes could be identified as characterizing teaching or learning in a generic sense; they could be generalizable. It is interesting to note that E. W. Eisner (1993) describes the same tension as a challenge to educational researchers.

   If thoughts and actions of individual teacher or learner are major factors of the progress of teaching or learning, understanding of teaching and learning will come from a study of individuals. Transferring research focus from a group or population to an individual is not reductionist if a holistic orientation to the study of individuals is taken as they learn, or teach or learn by teaching.

   The multiple factors that act in these teaching or learning episodes are best taken into account by a holistic study design. In order to deal with the multiplicity of factors two terms are used in the studies to provide a framework for observation, data collection methods and result table formats. The two terms and their components are:

   Intellectual competence
   - *attitudinal traits (including values and concerns)*
   - *perceptual traits (including expectations)*
   - *conceptions (including theories and beliefs)*
   - *abilities*

Intellectual performance

- *attitudinal states (expressed verbally or non-verbally)*
- *perceptions (awareness of the extent of student understanding, or development of the lesson in terms of prior intentions)*
- *decisions and behaviours about what to do and why as the lesson proceeds*

It becomes clear that a variety of observation and data gathering techniques are required to do such a holistic and yet detailed study that examines the teaching and learning of individual teachers. Longitudinal action research studies, descriptive, interpretive and evaluative, are used to assess the assertions or propositions that are based on constructivist theory and practice.

2. Understanding the nature and process of teaching and learning requires understanding of the mechanisms of interaction of the different components of intellectual competence and performance.

   The complexity of the interactions of teacher and learner require a research design that can take into account this complexity and integrate the many factors that influence these processes. The research must be integrated in terms of its purposes, focuses and methods. Understanding requires that four elements be resolved and included in the study design: the "what", "why", "how" and "how well" of teaching, learning and research.

3. The notion of constructivism holds for each of the components of intellectual competence, and enhances understanding of the nature of intellectual performance.

   Maintenance of a general view of constructivism when attempting to understand and explain the process of teaching and learning is an essential component of the research. An individual learns by active participation, processing new information in a framework of existing constructs and attributes. Effective teaching provides the learner an opportunity to build upon or reconstruct this framework. The research design of the various action research projects actively reflect constructivist notions in the very nature of the various pre-service and in–service program design, in the activities and data collection techniques planned and in the constant reflective practice of all collaborators. The remaining assertions all support this constructivist framework.

4. Enhanced metacognition is a principal goal of education, and is a productive focus for fostering intellectual development.

   The study design will encourage participants to "think about their thinking", to become aware of their thinking processes and then to have a greater degree of control and knowledge of them to apply in teaching and learning situations. Metacognition is a powerful tool toward constructivist practice and required reflective practice as described in Assertion 6.

5. Because of the complex and personal nature of change through intellectual development, progress toward the three aims, knowing more about teachers and teaching, more about learners and learning, and more about change and facilitating change, requires that the teacher and learner participate actively in the research.

   Constructivism requires active participation of the individual collaborators in both personal and group reflection to bring awareness of current thinking and to develop the ability to *build upon or reconstruct ones own current thinking. Techniques to assure such participation are built into the project designs; e.g., activity design, focused questions for group discussion, journal writing, interviews, validation processes where observations are verified by participants.*

6. This research should be based on reflection, and should be directed to constructing a pluralistic, relativistic epistemology. To this end, the reflection should be of two types: reflections on particulars of practice; phenomenological reflection.

   The research design encourages reflection of both types through the use of parallel reflective journal writing, reflection with peers, interviews, and surveys and ongoing collaborative practice.

7. Collaborative action research is a method that fosters intellectual development through reflection on practice. One measure of change is the extent to which participants accept certain responsibilities necessary for maintenance of the research.

   The aim of self–sustainability of action research by educators and researcher, beyond the term of any specific research project becomes a measure of the success of any action research project, which by nature are to bring about change in practice toward improving education.

Gunstone et al. (1989) presents the findings on one strand of a three-year longitudinal action research case study that focused on intending science teachers and their learning and their learning to teach. The study examines a sample group of pre–service teachers at Monash who are taking a specially designed pre-service course based upon the constructivist theory and practice that is expressed in a set of introductory propositions. The study involved two strands; one that followed the teachers, instructors and researcher, all active participants, through a year in the pre-service program, and another strand that followed four of the participating cohort from the pre-service program through their first two years of classroom practice. In reading the report one gains a strong sense of the continuous and linked nature of the various research projects this group carried out, given the assertions in the first paper and the propositions that build from the assertions. The design is primarily descriptive and interpretive but does evaluate to some degree, suggesting slight modification to one initial proposition, based on the findings of the study. The elements of encouraging metacognition, reflective practice and group collaboration are strong in the design. The ongoing nature of the action research, and the sustainability of the constructivist practices the research encouraged, is indicated as the focus of future research projects, including ongoing improvement of the Monash pre-service courses. Interviews, journal writing, formal and informal observations and discussions, surveys and course evaluations all served as sources of data to be analyzed and interpreted. Four individual students were selected and detailed case studies of each were prepared and the findings of these individual cases were combined with the more general findings of the case involving the whole class, the instructors and the researcher. The design of this study with many modes of data collection with three perspectives present is complex, reflecting the complexity of the task of determining how constructivist frameworks would function in the learning and learning to teach processes of intending science teachers.

Northfield (1989) provides the findings of a process of restructuring the practicum program at Monash to reflect constructivist theory and improve the experience for intending teachers by providing them with more of a school experience than a classroom experience. The aim was to provide greater opportunity to take part in the collaborative practice of the student teacher and their supervising teacher. Five guiding constructivist propositions are given at the beginning of the paper that report on collaborative action research involving practicum participants, cooperating teachers, university supervisors and the researcher. The practicum was extended from 3 weeks to 12 weeks and comments from interviews, journals and discussions are included to demonstrate the findings on the impact on the cooperating school, the appropriateness of the 12-week length of the practicum, and the relevancy of the tertiary pre-service preparation. The issue of transference of critical reflective practice to school environments not acquainted with or supportive of such methods is addressed. It is clear that the pattern of action research described above was followed in this project and the author concludes making a strong case for continuing action research toward examining all aspects of the practicum experience with mind to improving it. He suggests that the role of the student teacher, the tertiary institution and the school are all connected, and that close cooperation between all three is essential and long overdue.

White et al. (1989) examines the process of teaching and learning science in schools. The paper begins briefly recounting the purposes, design and findings of the PEEL action research project (Program for Enhancing Effective Learning) upon which the research project this paper reports on, builds. The research described aimed to involve teachers, students, consultants and researchers in addressing two sets of questions more or less simultaneously: What is the nature of classroom teaching and learning of science, and what are the mechanisms?

The action research process used in the PEEL project considered how an observer's judgement of aspects of a teacher's or student's intellectual competence, such as attitudes, perceptions, conceptions and abilities, compared with the teacher and student assessment of those aspects. The observer was to determine how well those attributes were employed in the planning and implementation of lessons and to compare their judgement with the teacher's or student's self–assessment.

Both the PEEL project and the follow-up project reported upon were extremely complex in design and involved massive collaboration of teachers, consultants, researchers and students. Again the action research design seems an appropriate, purposeful and productive research design for the complex investigations aimed at improving teaching and learning in science classrooms.

The Australian group's action research reports all have reference to the collection of voluminous data from a variety of sources. Although they provide excellent examples of quotes from journals, sample survey or evaluation instruments (often as completed by a participant) and a clear description of how various data gathering processes were put in place, they do not provide any detail as to how data were sieved, sorted, analyzed and brought into the form that is reported as the findings of the study. Although a description of how this was done may not be particularly exciting to many readers, it completes the picture and provides models for intending researchers to consider. The practice of leading into every research study with propositions or assertions can be bothersome to the reader as redundancy of the theoretical context often occurs. It would be ideal if all the research reports of this group were consolidated in one place with general propositions/assertions in one section of the document so the reader could refer to them before reading any particular study. A brief history of all the research to date and an index under appropriate categories would also be useful.

All of the studies by this group have an air of authenticity: they report the obstacles encountered, revisions to design necessitated by circumstance and provide quotes and examples which are always very believable. One gets a sense when reading their papers that they are all on a very committed, ongoing journey of learning about learning and teaching. This type of journey supports with action the constructivist and reflective practice foundations of their research. Statements from Eisner (1993) seem to reflect the beliefs the Monash group exemplify in their research.

> It (the major aim of educational research) has to do with the improvement of educational practice so that the lives of those who teach and learn are themselves enhanced. Put more succinctly, we do research to understand . . . Although we are making headway toward that end, there will continue to be difficulties and uncertainties, frustrations and obstacles. Working at the edge of incompetence takes courage (Eisner, 1993, p. 10).

Reflection as a Research Tool

The case studies described above, all based upon constructivist theory and practice, place major emphasis in their design on the development of reflective practice in teachers, researchers, students and university practicum supervisors. Reflective practice is seen by researchers in the area as an effective process for development of constructivist practice. The designs of the studies by the Australian team always optimize the opportunities for both reflection on practice and phenomenological reflection.

Osterman (1990) describes reflective practice in the following manner:

> Reflection is concentration and careful consideration, and reflective practice is the mindful consideration of one's successes and failures, and far more than the pursuit of knowledge for its own sake. Rather, reflective practice is a challenging, focused, and critical assessment of one's own behaviour as a means towards developing one's own craftsmanship. While reflection is certainly essential to the process, reflective practice is a dialectic process in which thought is integrally linked with action. (Osterman, 1990, p. 134)

She makes the point that reflective practice encourages more "constructed" knowing making the link between constructivism and reflection.

The role of reflection is addressed by the Australian research group of Baird, J. R., Fensham, P. J., Gunstone, R. F. & White, R T. (1991) in a naturalistic action research case study with constructivist underpinnings. They examine the role of individual and group reflection on practice in the classroom and of phenomenological reflection on the nature of science teaching and learning. In contrast to the previously discussed studies from this group, this study has no propositions or assertions before the case study proper begins. Three aims are clearly stated and the nature and purposes of the study along with the conceptual bases are provided in clear narrative. The study had two components; the preservice component involving 13 student teachers and teacher educators, and the inservice component involving 14 novice and experienced science teachers and 350 of their students. The study had a complex, but well described design. The authors collaborated with these groups to devise methods of changing classroom attitudes and behaviours of teachers and students. Volumes of data were collected from records of interviews, questionnaires and written evaluations. This study provided ample description of the various instruments used to encourage reflection with completed samples of each provided in the paper. A central finding of the study was that for teachers and students, both types of reflection helped improve their knowledge, awareness and control of themselves and their classroom practice.

Reflective Practice in the Netherlands

An interesting research paper on techniques conducive to reflective practice by Korthagen (1992) of the University of Utrecht, the Netherlands describes four techniques that can be used in teacher education to encourage teachers to reflect on their teaching practice and to support cognitive change. The techniques were used with a group of 18 student teachers at a Dutch university.

The study is an action research case study in which the author and fellow researchers or teaching colleagues, never identified but referred to as "we", participated. Through several years of use with student teachers these techniques were developed and refined to the point that the action researcher(s) felt they were working well. At this point, it was decided that a thorough investigation of how these techniques were working would be appropriate. A clear theoretical framework for the study is provided in the introduction and is based upon "cognitive schema"—a cognitive structure that represents organized knowledge about a given concept or type of stimulus (Fiske and Taylor, 1984, p. 140).

When considering the learning process, three methods of modifying the cognitive schema are considered: accretion, tuning and restructuring. These ideas of Rumelhart & Norman (1981) and Vosniadou & Brewer (1987) caused me to draw parallels between the cognitive schema and the functional paradigm of teachers and between the modifying of the schema and the shifting of the teacher's paradigm. When teachers are called upon to restructure their schemata, their frames of reference regarding teaching, Schon (1987) terms this reframing. To Schon, the process of reflection can promote the process of restructuring one's frames of reference; cognitive schema; functional paradigm. Reflection is further equated with the attempt to restructure one's mental representation of experience by DeJong and Korthagen (1989). In the attempt to design effective reflection techniques for student teachers Van Hiele's (1986) theory of levels in thinking was used. In this theory, qualitative changes in an individual's thinking about phenomena are characterized by changes in the nature and the number of relationships between the objects in one's cognitive schemata.

The case describes in detail four reflective techniques and the methods used to implement them in the classroom. It includes the observations of how the students responded to their implementation and the results of each technique. In the concluding section, based upon their experiences, the researchers interpret their findings and propose that a stepwise approach might be helpful in the promotion of reflection and with the restructuring of student teachers' cognition that conflicts with the educational theory taught in a teacher education program. This hypothesis and the four phases associated with it are clearly linked to the introductory theory and the findings reported in this study. It was finally concluded from the study that the four techniques tested did indeed promote this stepwise approach. However, a follow-up study, already in progress, to determine the effectiveness of the phase model will be needed. The researcher(s) will try to document the quantitative and qualitative changes in the subjective theories at which they are aiming.

Comparing the Dutch and Australian Studies

It is interesting to compare the Australian constructivist case studies and this Dutch case study, both being action research and both addressing the challenge of change in teachers perceptions of teaching and learning. Although they come from different theoretical perspectives, the encouragement of reflective practice is common to both. The Dutch study is much more focused, partly because the theory base seems more easily defined than a constructivist approach and partly because it zeroes in on four very discreet techniques. The Dutch study is easy to follow and the theory–practice link is strong. The methods of data gathering, selecting and analyzing are not explained and is not at all clear if collaborative research with colleagues was in play or if the author was doing the research on his own even through the term "we" is used throughout. In the Australian studies, collaboration and triangulation of perspectives increased validity. In the Dutch study, no details regarding collaboration or information as to how observations, interpretations or conclusions were validated is provided. Ethical concerns are not explicitly addressed in the Dutch study. However, in considering the case studies of both groups in regards to reflective practice one gains a strong sense that the two groups, both engaged in action research, have very similar aims even though their espoused theory may differ.

So far, in this brief survey of research and research design in the areas of teacher change, constructivism and reflective practice, action research case studies have clearly been the common research design. That design seems very appropriate for dealing with the complex processes of learning, teaching and learning to teach as well as with change in those processes. Let us now turn to consider grounded theory as design for informing these processes.

Grounded Theory in the Study of Teacher Change

Spector (1984) points to a shortage of qualified teachers and the quality and quantity of science taught in pre–college institutions as major issues in the US national crisis in science education. She believes that aspects of qualitative research have potential to inform those wishing to design effective change strategies to address this crisis. Grounded theory, a discursive approach to qualitative research that involves collecting and simultaneously analyzing data, is a method she describes in this study as having promise. The study involved social phenomenology as the basis for the methods applied in the study of five biology teachers faced with implementing new curriculum. A phenomenological approach involved consideration of what people say and do as the result of how they interact with their world and it attempts to see how things are from a particular person's point of view. An understanding of the working of a group or organization (such as the science classroom) and how those within these units define their world is important as is retaining the subjects own words because they provide important insight on how the subjects define their world.

This Spector study used a grounded approach with a role theory perspective to study five teachers who were implementing a new curriculum. The discursive method in this case study involved the data gathered during the study directing the design of each step of the study as it evolved. The categories, themes and subsequent hypotheses that emerged were "grounded" (have their initial foundation) in the data themselves. The method is used to generate hypotheses rather than to test hypotheses. Grounded theory research proposes generation of hypothesis that eventually will be tied together in theory. The method can be used for social units of any size, from nations to smaller units, such as a science class.

Role theory is used in this study to provide a structural framework for analysis and linking of data gathered. Role theory attempts to explain behaviour in relation to social position and obligations and privileges. It assumes that the expectations of organizations or society control actions of individuals in given positions. It opposes the personality theory that assumes an individual's behaviour is a result of their unique characteristics.

The aim of the study was to understand the factors influencing teachers' behaviours during a curriculum implementation period. The curriculum changes called for new roles for teachers; change from the role of information giver in the expository teaching of biology to the role of facilitator in an audio–tutorial college biology course taught in high school. Data were gathered from ongoing observations and interviews during a week-long university training workshop, three succeeding interviews, and three full day site visits during the academic year. As data were collected, they were analyzed from the role theory perspective. As the categories, themes and hypotheses emerged, they were presented to respondents for verification. Before the final interviews, the emergent identified hypotheses were reviewed, informally, by 30 teachers at science education meetings throughout the state. The statements that teachers could identify from their own experiences were kept to be further explored with the participants.

These hypotheses, "grounded" in the data, were connected into a theory and a structural model designed to illustrate the theory. The model suggested the factors that influence teachers to test new behaviours, to repeat new behaviours, and to make sufficient change that their behaviours are congruent with those demanded. The model indicated that to the extent that teachers perceived a potential for gaining satisfaction from making changes demanded by an innovation, they were willing to change their behaviours. Further, that a successful innovation depends on teachers making enough behavioural changes so their role behaviours become congruent with the role demands of the innovation.

> The present crisis in science education requires that policy makers and practitioners know what happens to teachers when role change is required for an innovation. This is central to the success of many innovations. The stress which teachers presently endure due to role conflicts, and organizational dysfunction may be increased in the near future when teachers are asked, or told, by their state and local education agencies to implement innovations in their classrooms designed to bring science programs from their existent state to the desired state for the 1980s and beyond. (Spector, 1984, p. 466)

This article puts forth the thesis that using qualitative methods and analyzing data from the perspective of role theory, and from an organization perspective will provide insight to generate relevant grounded theory. That theory can provide a basis for action that is needed by change agents to design effective strategies that can minimize stress and maximize innovation.

The grounded theory approach does indeed have great potential to provide information that can inform the process of change in teachers practice to reflect innovation in curriculum. This particular case study provides background in "grounded theory" and "role theory" with the design, results and conclusion clearly laid out. However, it is very sketchy on detail of the data, data collection and analysis methods and does not provide even one pertinent quote from a participants perspective, missing the opportunity to demonstrate the important component of grounded research, using the actual words of the subjects of the study for authenticity and meaning. It seems that this particular study report is mainly theoretical and is using a greatly simplified case to demonstrate the usefulness of such "grounded" methods to assist in the teacher change process demanded by the crisis in science education. It succeeds in providing a clear vision of what grounded theory and role theory are and is convincing as to the potential and applicability of such methods to the challenge of teacher change.

Spector & Gibson (1991) is a much more detailed case using grounded theory research. It is in this second study that the true power of grounded theory design became apparent. The purpose was to explore middle school students' perceptions of what factors facilitated their learning of science. Knowledge of the student perceptions of these factors has the potential to provide insight into ways of enhancing the effectiveness of middle school science teaching and teacher education. Studies dealing with students' perceptions of such factors were not found in the literature. Ample detail is provided in this study on the setting, subjects, methods and data analysis. The emergent categories are all supported with numerous examples and quotes from the subjects and the theoretical model developed is directly connected to the results of the analysis of the data. The emergent theory was connected well to the existing theory and implications were clearly drawn and consistent with the results of the study. The implications of this study were far reaching and important.

> Based on their own experience in science classrooms and the literature calling for restructuring of American schools in ways that are congruent with the emergent model, they concluded that the model had great promise for use in traditional middle schools and could also be used to enhance middle school science teacher education. This model suggests middle school science teacher education would be enhanced by helping prospective and in–service teachers develop and implement strategies that build trust, provide immersion in learning, and use inductive reasoning. (Spector & Gibson, 1991, p. 482)

It is interesting to me that trust is mentioned specifically as a goal for the classroom. The development of an atmosphere of trust was critical in the inservice project this study addresses. Both development of trust within the project and immersion of the field validation teachers in an active learning environment were feature goals of the whole inservice planning process. We also aimed to model the learning environment and constructivist processes that teachers would be called to develop in their classrooms as they implemented the new curriculum.

Teaching as In–dwelling Between Two Curriculum Worlds

Aoki (1986) describes with reference to a Grade 5 teacher called Miss O what he means by the term "in-dwelling". The article poignantly brings to light, with anecdotes from Miss O's classroom, the tension between curriculum as written (curriculum-as-planned) and curriculum-as-lived. The curriculum-as-lived is the actual result when the curriculum-as-planned is interpreted and implemented by an individual teacher in their classroom. Aoki recounts the various considerations and factors that influence the manner in which a teacher brings curriculum to life in their classroom. The thoughtful and effective creation of optimum learning situations for students through "tempering" of the curriculum as written to suit the students and total learning environment of the moment is described by Aoki as the very essence of the profession of teaching.

> Our Miss O knows that some of their colleagues who faithfully try to reproduce the curriculum-as-planned are not mindful of the lived situation, and that in so doing, they are unaware that they are making themselves into mere technical doers. In so making,

> they embrace merely a technical sense of excellence matched by a sense of compliance to the curriculum-as-plan, which exists outside of themselves. (Aoki, 1986, p. 9)

Aoki touches on the illusive quality of the art of teaching in this article; the process of dwelling between the curriculum-as-plan and curriculum-as-lived.

> Miss O realizes the challenges and difficulties that living within a Zone of Between entails, but she learns, too, that living as a teacher in tensionality is indeed living teaching as a mode of being that with all its ever–present risks, beckons the teacher to struggle to be true to what teaching essentially is. Miss O, our teacher, knows that in–dwelling in the zone between curriculum–as–plan and curriculum–as–lived experiences is not so much a matter of overcoming the tensionality but more a matter of dwelling a right within it. (Aoki, 1986, p. 9)

This description of "in-dwelling" and the tensionality associated with a teacher's day to day implementation of curriculum in their classroom really made a lot of sense to me. The constant reassessment of what one is doing in the classroom and why seems the ultimate in reflective practice and to me the mark of true professionalism. The teacher that focuses primarily on the curriculum-as-written is missing a major link in the teaching–learning experience. The process of really "good teaching" is an art with the illusive balance of curriculum and caring, of decisions of the moment and longer range planning. "In-dwelling" seems to have an almost spiritual dimension and to require an attitude of acceptance of the tensionality to continue effectively. I believe awareness and understanding of the curriculum-as-plan and intuitive sense of what is appropriate moment to moment in the classroom is required to "in-dwell", creating a positive curriculum-as-lived reality at the time. This teacher "in-dwelling" is a critical component (goal) to consider as new curriculum is being implemented. How can one influence teachers to incorporate new program directions into their classroom repertoire? A large variety of factors must be considered—physical setting, nature of students, availability of resources, class size, local resources, the curriculum-as-planned and teacher attitudes toward the changes. Once awareness of change directions is complete, supportive, neutral or negative attitudes or combinations of these can follow and result in either significant, little or no change in classroom practice. I believe the flexibility and creativity needed to be a true professional teacher would make this type of teacher, the type who spends much time "in-between" more open to change than a more technical teacher whose main concern is implementation of curriculum-as-planned. How would one investigate whether or not a teacher spends significant time and energy on the process Aoki calls "in-dwelling"? Classroom observations, teacher journal writing and interviews come to mind as possible tools for uncovering indications of critical reflection by teachers.

Reflecting and Relating

Alberta senior high science teachers have recently implemented a new high school science curriculum that called for major shifts in traditional teacher practice; the same challenge teachers in Australia, the UK and the USA are engaged in. Research indicates extensive and effective inservice activity with practicing teachers is an important component of a successful implementation of new curriculum. Having worked for three years in the planning and delivery of an extensive inservice program for field validation teachers, the various research articles reviewed for this paper have direct relevance to my experience. Reviewing the related research has affirmed many of my original ideas regarding what is required to encourage teachers to examine their role, determining if it is that of an expert, that of a facilitator of learning or somewhere in between. Teachers of the new programs were challenged to become a collaborator in learning with their students. When first confronted with the prospect of having to implement an integrated, STS focused science course at the Grade 10 level, teachers required the opportunity to examine their beliefs about what teaching science is—to become aware of the new program initiatives, to carefully consider them and hopefully integrate them into their "schema" or functional paradigms. This process required a clear understanding of the new program directions coupled with time and opportunity for teachers to question, examine, discuss and explore all facets of these directions in relation to their teaching practice.

Two major research designs address the issues of how teachers reframe their schema or functional paradigms of teaching practice, of how they come to critically reflect on their constructs, become aware of new directions and integrate them into this framework. These research designs are case studies of action research and case studies of grounded theory. In the studies considered the encouragement of reflective practice is shown to be an important ingredient in teacher change. Constructivist theory applied through action research has also demonstrated the power of constructivist practice. Grounded theory is less active than the collaborative mode used by the constructivists. Both camps are making progress in developing theories and models of practice that are improving the understanding of the complex activity of teaching and learning. Much remains to be researched; many questions remain unanswered. However, the various constructivist and grounded theories, models, and case studies and Dutch group's studies on techniques to encourage reflective practice are useful to practitioners who seek to improve their teaching and their students' learning. All the case studies considered ring true with my experience as a teacher and an educational inservice planner. The strong point of these case studies is the direct link between theory and practice, whether constructivist theory, grounded theory or Schon (1987) and Van Hiele's (1986) notions of conceptual development. The ideas are put into practice and then refined in an ongoing fashion through reflective practice. This is a very sensible and action oriented research approach for addressing the complex challenges of change facing science teachers today.

Educational Change: A Challenge We Have to Learn to Live With

Life experience has taught me much about change and I have come to realize that change is a constant factor to be dealt with in my personal and professional life.

Michael Fullan describes the challenge of change as follows:

> It is only by raising our consciousness and insights about the totality of educational change that we can do something about it. We will learn that it is not possible to solve 'the change problem', but we can learn to live with it more proactively and more productively. (Fullan, 1993, p. vii)

He describes the extent of change he believes we are facing and provides his vision for how such change can be effectively dealt with.

> It is a world where change is a journey of unknown destination, where problems are our friends, where seeking assistance is a sign of strength, where simultaneous top–down

> bottom–up initiatives merge, where collegiality and individualism coexist in productive tension. It is a world where change mirrors *life itself* in which you can never be perfectly happy or permanently in harmony, but where some people (those with knowledge of how to view, cope with and initiate change) manage much better than others. (Fullan, 1993, p. viii)

A clear case for the development of a new mindset for change is made by Fullan. He makes the point that change is endemic in our society yet we have an educational system that is fundamentally conservative. Introducing reforms one by one, even major ones, into a situation not basically organized to handle change results in reform getting a bad name. We cannot have a society where change is the norm alongside a conservative education system and expect anything but constant aggravation. Hence the challenge addressed in this book.

> Of all the institutions in society, education is the only one that potentially has the promise of fundamentally contributing to this goal. Yet education far from being a hotbed of teaching people to deal with change in basic ways is just the opposite. (Fullan, 1993, p. 4)

> Productive educational change at its core, is not the capacity to implement the latest policy, but rather the ability to survive the vicissitudes of planned and unplanned change while growing and developing (Fullan,1993, p. 5).

Fullan conceives of teachers as change agents and as extremely important change agents if we are to move ahead. He makes the point that change agentry without moral purpose is change for the sake of change.

> Education has a moral purpose. The moral purpose is to make a difference in the lives of students regardless of background, and to help produce citizens who can live and work productively in increasingly dynamically complex societies. (Fullan, 1993, p.4)

He reviews the complexities of change and provides lessons for seeing change in a new way, providing a framework for dealing with the forces of change. Seemingly incompatible factors, such as continuity and change, personal mastery and collective action, vision and openness, failure and success, and pressure and support are presented as coexisting prerequisites for successfully dealing with the change processes. The dynamic balance of these factors is an important skill required to cope with change today and into the future.

Using recent research and the concept of a learning organization, Fullan presents a model of how the education organization of the future could cope with change. He believes that the nature of schools may drastically change. Topics he discusses are how lack of vision and blind spots in the planning phases are counterproductive when dealing with change and how individualism and collaboration must coexist. He contends that the best learning organizations are collaborative and open to and proactive with their environments; they are able to cope successfully with change.

Fullan argues that:

> . . . the problem of productive change simply cannot be addressed unless we treat continuous teacher education—pre-service and inservice—as the major vehicle for producing teachers as moral agents of change. (Fullan, 1993 p. 7)

Fullan's vision of teachers who can successfully cope with change while teaching and learning this skill with their students is provided in his "Key Images for Teacher Preparation". The skills he considers critical for educators if they are to successfully cope with change and educate students are evident in this framework. According to Fullan, these are the goals for teacher pre-service and inservice programs.

Key Images for Teacher Preparation

(adapted from Fullan, 1993, pp. 115–116)

- Work with all students in an equitable, effective and caring manner by respecting diversity in relation to ethnicity, race, gender, and special needs of each learner.
- Be active learners who continuously seek, assess, apply and communicate knowledge as reflective practitioners throughout their careers.
- Develop and apply knowledge of curriculum, instruction, principles of learning, and evaluation needed to implement and monitor effective and evolving programs for all learners.
- Initiate, value and practice collaboration and partnerships with students, colleagues, parents, community, and social and business agencies.
- Appreciate and practice the principles, ethics and legal responsibilities of teaching as a profession.
- Develop a personal philosophy of teaching which is informed by and contributes to the organizational, community, societal and global contexts of education.

I believe these higher order goals describe important goals held by the Science Team, including myself; goals for the Senior High Science Curriculum Development and Implementation Project described in this study. Throughout the curriculum development and implementation project, these goals, although never formally articulated, were demonstrated.

In times of paradigm shift, Fullan explains we cannot expect the existing institutions to lead the way. Productive educational change will have to be initiated and catalyzed by individuals. The role of the individual, the kind of institutions they should be helping to shape and check and various strategies for taking action toward such changes are dealt with in his closing chapter where he presents his vision of an individual in a learning society.

Upon reviewing the literature I realize that constructivist theory, reflective practice, teachers' functional paradigms and Michael Fullan's recent work on change are all useful perspectives' in the examination of the inservice process addressed in my study. These constructs fit well with my teacher practical knowledge that came to be defined in a more formal way, first as an inservice planner and later as an educational researcher.

CHAPTER 4

A TEACHER'S STORY

My personal history, a half a century at this point, has been a saga of change: change in career aspirations and directions and numerous changes of teaching environment. Change is not unusual in a person's life story but the degree and nature of these change opportunities have strongly influenced my attitudes and beliefs regarding teaching practice and teacher professional development.

> Change is an integral part of the human condition and all individuals are called to become "change agents", having a mindset for change; the dynamic balance of integrated attitudes, knowledge and skills to work successfully within a changing environment. (Fullan, 1993, p. 4)

It was this variety of experiences, the continuous change of educational and teaching opportunities, that provided me with a rich and grounded preparation for the three year project I undertook for Alberta Education: the planning and implementation of inservice activities for the field validation teachers of the new senior high science programs during the 1991–92, 1992–93 and 1993–94 school years.

Teacher Practical Knowledge: Foundation of Functional Paradigms

Teacher practical knowledge (Duffee and Aikenhead, 1992) is the foundation of a teacher's functional paradigm. A constructivist approach and reflective practice promote continuous examination and refining or revising of a teaching paradigm. These two approaches are complementary; construction of new knowledge and meaning is based on reflection upon what one already knows and has meaning for. An ongoing process of reflecting and reaffirming, revising or replacing as appropriate to new experience enriches knowledge and meaning. Reflective and constructivist practices support flexibility within a teacher's paradigm, providing greater possibility for productive change. The value of teacher practical knowledge is very evident to me as a result of my own practical experience as a teacher, mother, community member and inservice and implementation planner. Duffee and Aikenhead consider teacher practical knowledge as having three components; past experiences, current teaching situation and a vision of the ideal. As I reflect on my teaching career, these components fit well with my experience. I will develop my personal teaching paradigm through a brief recounting of my life experiences and reflection upon these experiences; tracing the evolution of my present vision of teaching.

The eight basic premises Michael Fullan (1993, pp. 21–22) puts forth to teachers and learning organizations within society; premises that provide direction for successfully coping with change are woven into my personal paradigm development story where I believe they apply to my life as an educator. These premises are indicated in **CAPITALS**. Premises regarding teaching that I have personally developed through this recollection and reflection process are included at various points in the story and are indicated in ***italics***. It is from these major premises that my personal paradigm is drawn; the paradigm presented at the end of this chapter. Both Fullan's premises and my own premises are inserted into the story only once, at the point I felt they were beginning to become part of my teaching paradigm. These premises continued to evolve, becoming more central to my paradigm as time went on.

The Development of a Personal Paradigm

Teaching: A New Direction

I was born and educated in Edmonton, Alberta, Canada. My goal from an early age was to be a medical doctor, an internalized, unfulfilled goal of my father. Through a variety of circumstances including the loss of my mother to cancer and failure of an organic chemistry course in my second year of university, I redirected my education at the University of Alberta after completing my B.Sc. in biological sciences. I decided to try the Faculty of Education for one very practical reason; a single year of courses and successful completion of student teaching would enable me to get out into the real world and earn a living. To this point, I had never considered being a teacher and was extremely anxious as to the outcome of this venture. The student teaching experience in the after degree program in education changed my life. I discovered I loved teaching, really enjoying the interaction with students. I began to believe I had the ability, desire and drive to become truly good at this profession. Having gained the required confidence and credentials I began my teaching career, a ten-year period of continuous change.

CHANGE IS A JOURNEY, NOT A BLUEPRINT (Fullan, 1993, p. 21)

At this early stage in my career, I had a relatively technical view of teaching. I optimistically believed I would teach science to students by transmitting the knowledge of this subject I loved to them. Students needed a good grounding in science as it is important in their daily lives and in preparing them for the future. Although the "teacher as expert" and the "transmission model of teaching" were fully operational, they were tempered by an underlying concern for the good of the student.

The basic philosophy of a teacher is what expands or limits the potential of that teacher to make a positive difference in the lives of students—this vision of what is moral, determines if teachers can rise above the technical aspects of teaching to a more professional plane and deal pro-actively with change. Even as I began my teaching career, I had a sense of the "moral" dimension of teaching and a strong belief that I could help students learn and make a difference in their lives. Fullan speaks of the higher purpose of education and to goals that paralleled my belief as to why I was teaching.

> The moral purpose is to make a difference in the lives of students regardless of background, and to help produce citizens who can live and work productively in increasingly dynamically complex societies. (Fullan 1993, p. 18)

New Teacher, New School, New Program

The first year after graduation (1968–69) I taught in a large urban "academic vocational" junior high school (Grades 7–9), a school offering a new type of program. The school served a population of 500 students who had experienced great difficulty in elementary school, having failed at least one grade and demonstrating a variety of problems with learning. The academic programs provided were all remedial in nature and students were given opportunities to experience a wide variety of trades and services courses over the three years of junior high school, progressing, upon graduation, to either the world of work or regular vocational programs in high school (Grades 10–12). My teaching assignment was half time remedial science and half-time remedial reading. I had no background or training in either reading or remedial strategies for any subject and scrambled to survive my first year with a mix of students with low ability, learning disabilities, behaviour problems or combinations of the three.

> *I teach students, rather than subjects*
>
> *Although subject expertise is desirable, one can learn and teach simultaneously in a new area.*
>
> *It is hard work and directly challenges the concept of "teacher as expert."*

As a beginning teacher I had visions of the "perfect science lesson", of exciting inquiry activities, of stimulating discussions and ideal relationships with my students. The first week was a shock as I came face to face with the diversity of students, the low level of understanding and motivation and the challenge of discipline in the classroom. The diversity in my classroom was surprising; students who tried hard but could not read and could barely print their own name to relatively bright students with no self-discipline, unable to concentrate or sit in their seats. My vision of the ideal classroom and the reality of my situation were miles apart, posing a great dilemma.

VISION AND STRATEGIC PLANNING COME LATER: READY, FIRE, AIM (Fullan, 1993, p. 21)

It was not long before I learned that visioning and longer-range planning can be done only as one lives through the experience, not beforehand. Planning and visioning are fluid, ever evolving and flexible to allow for the changing circumstances of the classroom and school environment. Long range planning and visioning were ongoing and ever changing processes coming after reflection upon active participation in the teaching/learning experience.

Designing activities, lessons and assessment instruments to provide "successful" experiences for these students was very challenging, but of secondary importance to creating a classroom environment where learning was possible; an environment of mutual respect, security and trust.

> *Expertise in relating to students—development and maintenance of mutual respect and student/teacher rapport—is critical to establishing a learning environment.*
>
> *Develop flexibility and creativity; the ability to recognize and capitalize on the teaching/learning opportunities of the moment, comes with practice and confidence; with being comfortable with oneself and ones students.*
>
> *Creating a pleasant working environment, both physical and psychological, promotes learning.*

YOU CAN'T MANDATE WHAT MATTERS (Fullan, 1993, p. 21)

I discovered that determining where each student was at in their learning and having them work from that point while valuing their individual background experiences was critical to progress.

> *Value the knowledge, opinions and attitudes students come with; respect and consider them, working with them to move learning forward.*

It was during this first year that I learned, again through necessity, the value of consulting with colleagues.

> *"I don't know" can be an honest and powerful phrase. It can be the beginning of a learning experience for teacher and students.*

I was fortunate enough to have an exceptional and experienced remedial reading and language arts teacher with empathy and understanding for these students and inexperienced teachers like myself. She mentored me through not only the teaching of remedial reading and science but through the whole process of having to reconcile my idealistic goals with the reality of my teaching situation.

> *Interaction with colleagues stimulates professional growth. Avoid professional isolation.*

Success for every student was the focus of this school; build on strengths and seek the positive. Every student was to experience success in the school setting. For most of the students in this school, success experiences would be new as they had a history of failure. In this first year of teaching, I saw the self-confidence and learning of previously unsuccessful students blossom as they experienced success and support within the school environment. It took time to develop a learning environment that worked, but once established the results for most students were noticeable and rewarding to me as a teacher. The challenge of this first year, the constant reflection and revision as I sought better ways to reach these students, provided the initial seeds for what was my personal and ever evolving vision of teaching.

> *New endeavours and approaches may fail. Learn from failures, reflect, revise and try again. Continual reflection upon and revision of my teaching practice is required. Have high expectations of my students and believe in their ability to achieve and they will achieve.*

Several times, particularly early in the school year, I had questioned the sanity of my decision to become a teacher and considered the prospect of quitting. In the end I came to feel competent and confident in this teaching setting and regretted having to leave the school, the students and my new found professional colleagues.

> *My attitude will be reflected by my students so keep it positive and confident.*

PROBLEMS ARE OUR FRIENDS (Fullan, 1993, p. 21)

EVERY PERSON IS A CHANGE AGENT (Fullan, 1993, p. 21)

A Rural School Experience

Over the summer of 1969, I married and moved to a rural school setting. I took a teaching position at the same school as my husband and was delighted to be assigned Grade 7 and 8 science. Locally developed optional courses in junior high school were the order of the day and, consequently, I was required to develop and teach optional courses in biology and sociology for Grades 7, 8 and 9 as well as teach two Grade 10 typing classes. The many course preparations and the opportunity to develop one's own curriculum were professionally challenging and exhausting. I learned by plunging in and trying new ideas; some that succeeded and some that failed. I learned a lot and gained confidence in my ability to create effective learning environments and relationships with students across a wide variety of subjects, even when no formal curriculum guide was available.

> *Teaching is a learning process: living learning as a lifelong endeavour is an important model for students.*

This rural community school was quite different from the urban school I had experienced in the previous year. Living and working in the small community, one develops close social and collegial ties with many school staff members and the parents of the students you teach. The accessibility of open fields, aspen parkland and provincial parks made field studies more accessible than in the urban setting. Educational outings to the city were great adventures for many students, several who had never been the 70 kilometers or so to the "big city". I enjoyed the strong sense of community, the teaching of several members of the same family in different grades, the sports and social events with community members and fellow teachers.

My husband and I had always wanted to travel and teach in another area before settling down to have a family. We had both just completed our two-year probationary period and had received our permanent Alberta teaching certificates. It was a difficult decision to leave at the end of the school year as we had developed strong community and school ties. We decided to head out.

> *Become comfortable with a degree of risk taking; have the courage to try something new.*

The World Beckons: An Australian Experience

CONNECTION WITH THE WIDER ENVIRONMENT IS CRITICAL FOR SUCCESS
(Fullan, 1993, p. 22)

I was interested in teaching in Northern Canada. When we applied to the Northwest Territories and the Yukon there were large numbers of more experienced applicants from other countries, especially from the UK and we were told to apply again when we had more experience. In 1970 the Australian state of New South Wales was running advertisements in the newspapers indicating a need for teachers. If one applied and was accepted, passage and salary from time of departure was paid and an orientation course provided upon arrival. In return, the teacher was required to sign a contract agreeing to accept and fulfill a full school year posting anywhere in New South Wales. It was an offer too good to refuse, with the added adventure of not knowing where one would be posted. We applied and were accepted and after a seventeen day ocean voyage arrived in Sydney, just as school broke up for the six-week summer break over December and January. We had the full six-week summer break to take part in two weeks of orientation with about 100 other North American teachers and to tour and become acclimatized to Australia.

Much to our surprise, we were posted right in the western suburbs of Sydney for the 1971 school year. My husband was assigned to one of only two co-educational high schools in the city and I was assigned to a girls' high school. We had fully expected to be sent "beyond the black stump", to a sheep station in the far reaches of New South Wales. We later discovered that many Australian teachers considered teaching in the western suburbs an unacceptable option as it was a migrant area, populated largely by new Australian immigrants. Thus, several schools in the area were short-staffed and many of our North American colleagues from the orientation course ended up teaching in the western suburbs of Sydney as well. We were able to keep in touch, sharing our perceptions and experiences at the various schools in this area.

It was quite a transition. The much more formal teaching environment with school uniforms, students queuing up at your classroom door and not entering until you invited them in. At the time, the New South Wales science curriculum was similar to Alberta's in Forms 1–3 (Grades 7–9), but very different at the Form 4 (Grade 10) level as aspects of biology, chemistry, physics, geology, astronomy, meteorology were all taught in that year. In Alberta, specialist courses in biology, chemistry and physics were provided and no general course was available at this level other than the remedial Science 11 course. For the first time in my teaching career my assignment was all science; science in Forms 1–4 (Grades 7–10). The more informal discussions we were accustomed to with classes in Alberta were foreign to these students. They expected to listen to lectures and copy notes. It took a few months for them to relax and participate more actively in their learning; to get to know me, and to enter into classroom discussion. This was a change for them and a degree of rapport and trust had to be built up before the change could occur. Teaching all girls was new to me as was the strong formal focus on discipline and decorum. During regimented morning assemblies in the hot summer sun, students standing at attention in uniform, often fainted and were carried off on stretchers. The official who inspected our classroom practice checked for such essentials as our initials in the lower right corner of every page of every students notebook. I often thought at the time, and still believe, that the ideal teaching environment would lay somewhere between the formal, regimented Australian model and the Alberta model at that time which allowed much more freedom and much less responsibility on the part of the student. It is a hard balance to strike.

INDIVIDUALISM AND COLLECTIVISM HAVE EQUAL POWER (Fullan, 1993, p. 21)

NEITHER CENTRALIZATION NOR DECENTRALIZATION WORKS (Fullan, 1993, p. 22)

Students were streamed according to their marks in the previous year(s) and classes were designated as A, B, C… from highest to lowest, with larger schools sometimes having classes at a particular form down to letters such as P and Q. The students in the lower level classes were often referred to as "school leavers". Even though this school was in a so called "tough area" I had a great sense of accomplishment with these students, even with the school leavers, those students who left the day of their 15th birthday. I felt very positive about my year teaching in this girls' school and I felt I had "connected" with most of the girls in either an academic and/or a personal way, feeling I had made a positive contribution to their lives. At that time there were jobs aplenty for school leavers and such early termination of education was a common and accepted event. Once again I was fortunate to be working with very competent and dedicated teachers, both Australian and North American. I developed a tremendous amount of respect for my colleagues as we worked as a team, supporting and helping one another on a daily basis.

Papua New Guinea: A New Perspective

Shortly before the end of the school year, we met Australian teachers who had recently returned from teaching assignments in Papua New Guinea, then a protectorate of Australia. Papua New Guinea appealed to our interest in nature and natural history and to our spirit of adventure. The country was in need of teachers, particularly science teachers, and preference was given to married couples, especially when both were teachers. We investigated, applied and were accepted being given two-year contracts, contingent on satisfactory service, for the 1972 and 1973 school years.

Our first posting was to a large residential senior high school located 25 miles out of Rabaul on West New Britain Island. It was one of two senior high schools in the country to offer Forms 5 and 6 (Grades 11 and 12). At that time, only 4% of the students who entered elementary school continued on to a senior high school. The students were fluent in English as they had been educated in English from mid-elementary school on. The school drew a great variety of students representing very different language and cultural groups across Papua New Guinea. Australia was governing Papua New Guinea at that time and was doing an admirable job in the realm of high school education. I was pleased to find the school and the teacher and student accommodations were relatively well-equipped and maintained, providing a comfortable and serviceable environment for the approximately 550 students and 25 teachers. The school was set in the rainforest, approximately 6 miles from the sea; a lush and truly beautiful area. Teachers lived on site and were mainly Australian and British, with two indigenous teachers and ourselves, the two Canadians.

Australian curriculum was being followed and my assignment involved teaching general sciences, agriculture and English to Forms 2, 4 and 5 (Grades 9, 10 and 11). The students were well behaved and cooperative; extremely easy and enjoyable to teach. The atmosphere was less formal than in Australia, although the uniforms, assemblies and general school processes followed the Australian/British model. Inspectors who monitored our classes again seemed to place more priority on checking the marking of each page of a students notebook than on encouraging innovative and effective teaching and assessment strategies. To avoid the heat of the day, classes were run from 7:00 AM to 1:00 PM with the afternoons being dedicated to sports and school maintenance projects. There was a compulsory, supervised student study period of two hours every week night. Teachers were scheduled to supervise the evening study period as well as the student project or "work parade" groups which were responsible for the total maintenance of the school facilities and the grounds. My maintenance group of ten students and myself was involved two afternoons a week during "work parade time", 2:00–4:00 PM, sanding and varnishing the desks in each classroom in rotation—a never-ending task in a 25-room school complex. Although major construction and repairs were handled by the Australian government, students took care of the whole school complex on a daily basis. Everyone pulled together and it was a unique experience to be part of this close-knit educational community for a year. As Rabaul, the nearest centre of about 4000 people, was a 2-hour journey on a tortuous dirt road, we only left the school for supplies on Saturdays. I came to know the other teachers and the students in a much closer and personal manner than at any other time in my teaching career.

While teaching here I discovered that the principal carried some very racist attitudes toward the indigenous students of the school. I had to call for the support of the local educational supervisor to assure my agriculture class, twenty-six Grade 10 boys, would have the opportunity to experience the prescribed curriculum for this optional subject. My principal had advised me that my agriculture class would spend their class time clearing the surrounding rainforest to establish and maintain a garden to supplement the schools' daily menu. Although gardening was an important skill, it was unfair to have these students constantly labouring in the time allocated for their agriculture program, a program that was much broader in scope.

> *Teaching requires an ethical (moral) foundation; the good of the student is central and one must be prepared to challenge individuals and circumstances you judge are exploitive of students.*

At that time, although the school was well run, the teachers very proficient, and the students academically successful, the whole system was very colonial, seeming to place little value on the various cultures of the indigenous peoples of Papua New Guinea. The curriculum had not been adapted to the local culture or environment to any great degree, art and music perhaps being the exceptions. A teachers college had been established in the highlands at Goroka and indigenous teachers were beginning to graduate and take teaching positions, particularly in elementary classrooms. Few senior high school teachers were indigenous at that time. It would be very interesting to return and observe first-hand the changes that have taken place over the last 22 years. With Papua New Guinea gaining independence and local teachers being trained in numbers allowing them to take over the majority of positions available, I expect the situation would now be quite different. One would hope that the current curriculum would be directly related to Papua New Guinea students' environment and culture and no longer have a distinctly Australian context.

Near the end of that first year of teaching in PNG my husband and I, after our inspections, were promoted. This resulted a slight rise in pay and a transfer to two mainland high schools, one in the town of Lae and the other an indigenous boarding school just out of that same town. My assigned school was the inter–racial urban day school with students in Forms 1–4 (Grades 7–10). The teaching assignment was science, mathematics and health. Class sizes were small (15–25 students) and the students got along very well with one another in spite of a large diversity of cultural backgrounds. The school was well-equipped, well-staffed and again had a very pleasant and cooperative working atmosphere. The variation in student cultural backgrounds provided for interesting discussions in science and health classes with some students being from Australia, some from Great Britain and others of indigenous or Chinese origin. I found myself missing the more direct and extended involvement with students which the previous year at the boarding school had afforded, but adjusted back to a situation more like the one I had come from in Canada. By the end of the 1973 school year my husband and I decided to head back to Canada. It had been three years since we had seen our families.

Home to Canada: A Large Urban School

Once back in Edmonton, I obtained a position for the 1973–74 school year at an urban high school teaching Grade 10 and 11 Biology, Grade 11 Chemistry, and Grade 10 remedial science. I certainly enjoyed teaching biology in high school as to this point I had never had an opportunity to teach a full course in my major area of preparation. Chemistry was a new course to me and I quickly discovered that the curriculum included quantum mechanics, a topic I had not dealt with until my first year in university. The chemistry class I had was very small; only eight students and I was fortunate once again to find a very experienced colleague who worked with me my first time through. I had four remedial science classes at the Grade 10 level and enjoyed the flexibility of the curriculum for this course. I involved the students in the development of the course outline and found these classes challenging but very rewarding to teach. This was to be my last year of full-time teaching for a few years; in fact, the last time I would have a full-time continuous teaching contract. I resigned from my school board to become an almost full-time mother for the next few years.

Parenting and My Personal Paradigm

My first daughter was born in late 1974 and the second in early 1978. As my daughters grew up, I experienced their development and learning in a very personal way. I came face to face with the realities and tensions of parenting; the relationship between nurturing and encouraging personal responsibility and self-esteem, of creating learning environments that allowed freedom and personal development and yet encouraged cooperation and caring for others, of establishing open communication, caring and trust while maintaining and encouraging self-discipline. Parenting is a very humbling experience; for me, it was the ultimate example of the all too common conflict between theory and practice. Parenting has brought the two together in a very meaningful way and caused me to constantly reflect, evaluate and revise my personal theories of teaching while providing additional practical experience. I find even today, as my girls are in their late teens, I am called upon to reassess my role as a parent, often refining my manner of interacting with them in the light of new circumstances. Parenting, like teaching, has been an ongoing process of change informed by reflection and action. I am continually constructing new meanings of what my relationship to my children is based upon the present circumstances, my past experiences with them and my vision of the relationship I wish to have with them in the future.

A Caring Community: Continuing Personal Growth

During my time at home with my children, before they entered school, I became actively involved in a local church group. Participation in this group afforded the time and opportunity for developing mutually supportive relationships with women who had children of the same age group as my own. I had found a nurturing and intellectually stimulating group of women who were a major source of inspiration and support. Our children have grown up together and the many projects we undertook, both for our children and for our own personal growth, provided opportunities for development of leadership skills, public speaking skills and self-confidence. This experience enriched the lives of my children and certainly further developed my organizational, communicational and interpersonal skills as I was challenged to organize conferences, and develop and present educational programs to adults and children. The sense of belonging to a caring and supportive community strengthened my confidence and sense of self-worth. During this time away from full-time classroom teaching, I had the opportunity to explore and further develop my own personal philosophy of life; to encounter many new ideas from feminist and various theological perspectives. Through the experiences of this period of my life, I became a better teacher; a more mature and whole person better able to work with others.

Transition Teaching

From the time my first daughter was born and until the younger one was in kindergarten, I did not return to teaching on a full-time basis. During this period, I taught two semesters of adult night classes in Grade 10 and 11 biology, taught Grade 10 and 11 biology for 4/7 time over a one-year period at a city high school and did two terms as a teaching assistant in the Department of Microbiology at the University of Alberta. I thoroughly enjoyed working with adults and with university students. Their focus and commitment to their studies was in sharp contrast to that of many of the younger and less motivated secondary school students I had worked with in the past.

Supply Teaching: Daily Diversity

In 1984, when both my girls were in school, I sought full-time employment as a teacher in Edmonton. No permanent contracts were available for secondary science teachers as there was an over supply of teachers and one had to substitute teach, often for several years before gaining a position, and even then, such position would likely be a temporary one-year posting. I began substitute/supply teaching in junior and senior high schools throughout the city. Over the next two school years, I was called to teach a wide variety of subjects: sciences, mathematics, social studies, English, physical education, business education, music, and even French one blizzardy day. I visited all the city's public system high schools several times and approximately half of the city's junior high schools. When I began substitute teaching the assignments were mainly a day to a week in length, replacing teachers who were ill or on personal leave. Once I became known in the schools, science teachers began to request me and I was called to teach science more often than other subjects. Requests to replace teachers who were absent for more extended periods of time, perhaps up to two or three months resulted in longer term placements for me. The experience of substitute teaching for two years greatly enriched my teaching repertoire as I had the opportunity to experience a wide variety of teaching styles, activities, assignments, assessment tools, classroom and laboratory set-ups and students. As a substitute teacher in the various secondary schools, I never hesitated to ask for assistance when I needed it. Without exception, the teachers I asked for help were more than pleased to give me the information, advice or support I needed.

As I worked within various large urban high school science departments, I developed a understanding of how each group of science teachers worked. The curriculum had been stable for a number of years; little was changing. Most senior high science teachers were experts in one discipline; biology, chemistry or physics. Some teachers did teach two disciplines, but this was the exception rather than the rule. Teachers within a single discipline area would come together to review and revise common unit or final exams, perhaps to coordinate a laboratory activity schedule to efficiently utilize a laboratory assistant's time, to decide the film ordering schedule or review and revise common course outlines distributed to students and parents. Teachers generally rotated the responsibility for the unit and final examination preparation from semester to semester or year to year. Such common frameworks prescribed the order and timing of curriculum coverage; all teachers would reach defined curriculum points at the same time. These frameworks meshed well with the school reporting periods.

Such formal frameworks tended to limit the possibilities for teachers personal modification of the curriculum. Professional classroom practice within these frameworks tended to be an individual and private professional matter with a team or consultative approach encouraging exploration and development of new teaching strategies or assessment methods being the exception rather than the rule. From my observations, although the social atmosphere could be very congenial and cooperation to maintain the common frameworks high, there was limited personal professional exchange regarding classroom practice. Often, as I described an activity a teacher had left for me to other teachers in the staff room, other teachers would be surprised as they had not known that their colleague was doing such an activity. I found the few teachers who were trying new and innovative strategies in their classrooms tended not to share these with their colleagues. High value appeared to be placed on independence, on self-sufficiency as a classroom teacher and on an acceptable standard of academic performance by one's students. Occasionally, two or three like minded teachers would work collaboratively on classroom practice issues and if scheduling allowed, develop a team teaching learning environment.

I noted that when a teacher was assigned Science 11, a remedial general science course at the Grade 10 level, they tended to consult other teachers to a greater degree as this course was more integrated in nature, requiring teachers to move out of their area of discipline expertise.

Two years of substitute teaching were followed by two single year contracts to teach at two different city high schools. At the first high school, for the first time in my teaching career, I taught four Grade 12 level biology classes, two each semester along with several; Grade 10 biology classes. I experienced the anxiety and extra responsibility of teaching the diploma examination year biology students, wondering whether my inexperienced Grade 12 biology classroom practice would prepare my students adequately for this important external examination. As it turned out, the results of the first semester classes were fine and once I had been through the course this first time my confidence grew with my students' success. I became more relaxed in semester two, branching out and bringing more of myself and my students' contexts into the course. I endeavoured to personalize the curriculum to a greater degree but found the schedule of common laboratory activities and unit tests adhered to in the school did not provide the flexibility needed for any major revisions in the manner the curriculum was presented. In the next year, I was assigned to a new school and three sciences; Grade 10 (IB) biology, physics and experimental chemistry course. I experienced the tremendous anxiety and stress of preparing and presenting several courses I had not yet taught, all at the same time. A feeling of overload and of not doing the best by my students set in. I made it through the year, doing an adequate, but not self-satisfying job. The need for ample time, abundant energy, and personal and professional support for teachers implementing new courses, became abundantly clear to me. A new school and new courses to teach each year places a lot of stress on a teacher. I longed to stay in one school for more than one year. This was not to be so. I was placed on the substitute teaching list once again in the fall of 1988 as a full year placement was unavailable.

It was at this time that I was called by Alberta Education for an interview. The new senior high science program development had begun and the program manager was seeking an assistant. A rather drastic change in my career resulted when I became that assistant and began my association with Alberta Education. I joined Alberta Education to participate in an innovative and exciting project; a major curriculum change in senior high science. I was to work in the areas of program development, resource selection and development and teacher inservice. Change had been an integral part of my teaching career to this point and although I was apprehensive about my ability to make a valuable contribution to this yet to be defined project, I was excited and invigorated at the prospect of being in a new learning environment. A steady place of employment and continuity from day to day, two factors substitute teaching could not afford, were an added bonus.

A Profession of Considered Action and Continuing Change

As a result of the variety of experiences in my life, I had developed the following premises regarding the practice of teaching. These, although previously inserted into the story, are summarized for review as follows.

- teaching requires an ethical (moral) foundation; the good of the student is central and one must be prepared to challenge individuals and circumstances you judge are exploitive of students.
- Expertise in relating to students—development and maintenance of mutual respect and student/teacher rapport—is critical to establishing a learning environment.
- Develop flexibility and creativity; the ability to recognize and capitalize on the teaching/learning opportunities of the moment, comes with practice and confidence; with being comfortable with oneself and ones students.
- I teach students rather than subjects.
- Value the knowledge, opinions and attitudes students come with; respect and consider them, working with them to move learning forward.
- Have high expectations of my students and believe in their ability to achieve and they will achieve—build on strengths, don't focus on weaknesses.
- My attitude will be reflected by my students, so keep it positive and confident.
- Teaching is a learning process: living learning as a lifelong endeavour is an important model for students.
- Although subject expertise is desirable, one can learn and teach simultaneously in a new subject area. It is hard work and directly challenges the concept of "teacher as expert".
- Continual reflection upon and revision of my teaching practice is required.
- "I don't know" can be an honest and powerful phrase. It can be the beginning of a learning experience for student and/or teacher.
- Become comfortable with a degree of risk taking; have the courage to try new approaches, to fail, reflect, revise and to try again.
- Interaction with colleagues stimulates professional growth; avoid professional isolation.
- Creating a pleasant working environment, both physical and psychological, promotes learning.

Current Personal Paradigm

The result of this reflection and analysis of my life experiences is the description of my personal paradigm of teaching that follows. This paradigm, my current vision of teaching, will continue to evolve throughout my life given new experiences in the education area.

> Teaching is a moral endeavour, a challenging journey; ever evolving toward the creation of more effective learning environments for students. Students are partners in the journey of learning. As a teacher I reflect and refine, research and revise, becoming better at engaging students in the journey; better at creating environments conducive to learning. I model learning as a lifelong endeavour, as an on-going process of personal growth. Mutual respect, cooperation and good communication are essential in this learning environment. Flexibility, including the ability to capitalize on the opportunities of the moment, coupled with a sense of humour, facilitate the learning process. My attitudes and beliefs, the examples I set for students, are critical to learning and an important influence

in the formation of student attitudes and beliefs. I engage students in learning with the purpose of developing caring, responsible and contributing members of society.

A Teacher Practitioner's Perspective Brought to Alberta Education

The foundation for working in a reflective, cooperative, communicative and supportive manner in an ever changing environment was laid throughout my life as a teacher, mother and community member. This foundation would be built upon as I became involved in the project I had never anticipated: the Alberta Education senior high science inservice and implementation project, the subject of this study.

CHAPTER 5

AN INSERVICE PROJECT: THREE PERSPECTIVES

A description, analysis and evaluation of the dynamic inservice planning and implementation process undertaken to support the new Alberta Senior High Science program will reveal the strengths and weaknesses in the process. It will inform those charged with similar projects in the future; projects intended to support teachers as they implement new centrally developed curriculum. To tell the story I will present three perspectives on the project.

These three perspectives are:

1. my **personal** perspective as project manager and participant, presented primarily in the *Personal Reflections* section but also woven into discussions found in the other two sections.

2. the **field validation teachers**' perspective presented as an analysis and discussion of their inservice journal comments in the *Teacher Participant Reflections* section.

3. the perspectives of the **Alberta Education Science Team members**, my closest partners in inservice planning and leadership, have also been presented. A group interview was conducted with team members after the teacher journal comment analysis was complete. The interview, recorded on audiotape and videotape, was transcribed and then summarized and discussed in relation to the other two perspectives in the *Science Team Reflections* section of this chapter. The interview transcript is presented in Appendix B.

The story of this inservice project, along with some initial analysis and evaluation of the process is presented in this chapter and is continued with a major focus on analysis and evaluation in Chapter 6.

Perspective One: Personal Reflections

The field validation of the new Senior High Science programs spanned three school years; September through June 1991–92, 1992–93 and 1993–94. As manager of the inservice component of this project, I was responsible for the development and implementation of inservice activities and the provision of additional support for the field validation teachers. The field validation teachers were the group of teachers doing the pilot trials of the new program and resources in their classrooms. The field validation was one school year ahead of the scheduled provincial implementation date for each new course within the new Senior High Science program. Teacher support beyond the inservice sessions included ongoing communication and coordination, teacher resource manual development, and the identification, provincial authorization and/or listing of appropriate print, audio-visual and computer software resources for teachers and students. I began this task in January 1991 and it was completed in July of 1994.

The primary focus of my inservice work was the field validation teachers. This important group of program pioneers represented only a small percentage of all senior high science teachers in Alberta, all of whom required information and support to implement the new programs. Alberta Education in partnership with school jurisdictions, post-secondary institutions and the Alberta Teachers' Association were jointly charged with the task of providing teacher support for the majority of teachers in the province who would be implementing the new program a year after the field validation teachers.

Alberta Education's role in supporting the majority of senior high science teachers not involved in the field validation, was to provide day-long information sessions for them in the spring before the September implementation of each year of the program (3 years). In addition, Alberta Education developed teacher resource manuals for each new course and manuals that included extensive support resource listings with annotations.

The information sessions were condensed day long inservice sessions with very direct links to the field validation experience and the field validation teachers. The field validation process, particularly the field validation inservice component, provided a strong base for the planning and presenting of the provincial information sessions. As far as possible, field validation teachers were called upon to provide leadership for the information sessions. A field validation teacher worked in partnership with a Science Team member to select and set up approximately 10 activity stations for particular units of the new science programs. The field validation teachers would introduce each group of participants to the unit activity stations with a description of how the unit worked in their classroom with practical comments on the new program and resources. Questions were answered by the teacher leader before the activities were explored, during the exploration time and after in a brief summary session. Field validation teacher leaders also answered questions in the final plenary session.

I found that the tasks of providing field validation teacher inservice activities, conducting provincial information sessions, developing teacher resource manuals and the listing of appropriate print, audio–visual and computer software resources were complementary and valuable connections were easily made between the different task areas.

The Minister's Advisory Committee on Senior High Science continued to meet to consider the revisions made to the Senior High Science programs in response to the field validation process. On three occasions, I was called to report to this committee on the field validation teacher inservice sessions and the provincial information sessions. A synopsis of the field validation teachers' evaluation of inservice activities and teachers' evaluations of the information sessions were an important component of these reports.

Initial Thoughts

As I began this inservice and implementation project, I asked the question **"If I were implementing the new science program in my classroom what would I need to assist me?"** In the process of identifying these needs I drew upon my experience: experience as a classroom teacher, experience at Alberta Education as a curriculum developer and manager of the much smaller Science 14–24 field validation project, and experience as a homemaker and mother.

Through life experience I have come to realize that trust is critical in families, in the classroom and in field validation projects. How does an atmosphere of trust develop? If the people involved have a sense of common purpose and share experiences supported by good communication, a caring and collaborative process can evolve. Such a process can lead to the trust and security needed for positive progress.

My initial thoughts as to what would have to be done to accomplish such an atmosphere of trust within this project were:

- establish a good working rapport with the teachers; a trust between them and the Alberta Education Science Team; a sense of common purpose
- respond to teachers' needs—plan in a flexible, consultative and reflective manner; an ongoing cycle of consultation, planning, action, evaluation and revision
- develop and use effective methods to gather the beliefs, feelings and ideas of teachers regarding the curriculum change, the field validation process and specifically the inservice activities
- develop inservice programming and support resources to meet the ongoing needs identified by the teachers while also meeting the goals of the new curriculum
- maximize the teacher support possible within the bounds of the human resources, budget and partnerships available
- keep support directly linked to the teachers' expressed needs and the reality they face in the classroom
- establish and maintain good communication, formal and informal, to keep the field validation project, particularly the inservice component, a collaborative and professionally satisfying venture for teachers and the Alberta Education Science Team
- maximize field validation teacher leadership in inservice sessions and teacher support resource development. "Teachers working with teachers" is more effective than the Alberta Education Science Team providing the majority of the leadership. The Science Team would work collaboratively with field validation teachers to provide the leadership required within the project
- provide a pleasant, efficient and effective physical setting for inservice sessions—good session rooms, food, accommodation and hospitality. These factors can have major effects on how receptive the inservice participants are to the inservice activities.

Alberta Education Explores the Inservice Challenge: Plans Evolve

As mentioned in Chapter 2, the Alberta Senior High Science curriculum development project was long and controversial with delays of implementation occurring twice. As a result of these delays, several rounds of formal and informal consultation and cooperative planning for teacher inservice and support took place before the actual field validation project began.

In September of 1988, Alberta Education held an initial internal inservice planning meeting drawing together the five Alberta Education science consultants from the Regional Offices of Alberta Education in each zone, the four Student Evaluation Branch science diploma examination managers, the Alberta Distance Learning Centre science project manager, and the Curriculum Standards Branch secondary science representatives including myself. This meeting was a brainstorming session and an examination of the "cascade model" of curriculum implementation described in Chapter 2. The Junior High Science program provincial information sessions had recently been completed and the experience of the leaders of these sessions was shared. The Science 14–24 field validation, provincial information sessions and implementation had recently been completed and the experience of this project was also brought to the discussions. Although this meeting turned out, because of subsequent program implementation delays, to be very early in the inservice planning process several salient points emerged:

- the cascade model does not work well and it needs to be supplemented to support implementation of the major changes required in the new program
- field validation teachers will require more inservice time and support than Alberta Education has previously offered
- good quality student and teacher resources must be available on time
- ongoing and clear communication to administrators and teachers regarding the program changes and implementation is essential
- the Curriculum Standards Branch and the Student Evaluation Branch must work together closely and present a clear and consistent plan for curriculum implementation
- the evaluation and assessment component is very important to students, teachers, administrators and parents—particularly the provincial diploma examinations to be administered in the final year of each of the new science courses.

A record of the points that emerged at this initial meeting was kept and served as a starting point when the formal planning of the inservice project began in January 1991.

Initial Needs Assessment

In June of 1990, the Alberta Education Science Team held information and discussion meetings for teachers, curriculum leaders and educational administrators around the province. Discussion of new program implementation needs was an important agenda item at all of these meetings attended by approximately 400 teachers. At these meetings, the Curriculum Standards Branch Science Team presented the latest drafts of the various programs of studies to teachers, school jurisdiction curriculum supervisors and school or jurisdiction administrators for consideration, discussion and response. They also asked the various stakeholders what they felt would be needed to support teachers implementing this new curriculum. Informal discussions followed and participants' comments were recorded by the Alberta Education representatives present.

Background, Considerations and Deliberation: the Inservice Program Evolves

In January 1991, I met with the Science Team to consider the collected needs assessment information regarding what teachers would require to successfully implement the new senior high science programs. Decisions had to be made regarding the nature and substance of the inservice activities we would be developing for the field validation teachers over the three-year project. Through discussion, the Science Team identified the following items as important considerations that ideally would be addressed as the teacher inservice and support component of the project that was planned and implemented.

General Considerations

- Use a consultative inservice planning process (teachers/colleagues/university educators/ Alberta Teachers' Association etc.).
- Consider the diversity of school environments.
- Consider the diversity of teacher perspectives on the proposed changes.
- Provide appropriate student and teacher resources on schedule.
- Define the relationship between curriculum changes and changes in assessment and evaluation strategies, and support the connection with inservice activity and resources.
- Provide sufficient inservice time for teacher awareness, commitment and implementation skills to develop.
- Teacher leadership in sessions is very desirable—maximize it.
- Teacher recognition is critical.
- Quality of venue, food services and accommodation is important to success of inservice activities.

School Considerations

- School administration's support for the new program directions and for the teachers implementing them is very important.
- Cooperation among science teachers in each school (the team approach) is to be encouraged and supported.
- Special provision for teachers working alone in their school to network with other teachers will be needed.
- Student counselling for science course planning is critical; guidance counsellor, teacher, student and parent understanding and support is necessary.
- Community awareness and support of new programs should be encouraged.

Communication, Trust Building, Inservice Evaluation and Teacher Support Considerations

- Communication, collegiality and trust between the Alberta Education Science Team and the field validation teachers is critical.
- Teleconferences as a communication/support mechanism has proved effective in previous projects and will be used.
- Use of teacher participant journals as an inservice evaluation and trust building tool will be explored.
- Access to ongoing formal and informal implementation assistance and support is needed—teachers must know they can turn to the Science Team for reliable help.

The Science Team agreed these points provided important goals that we would strive to address as the inservice project unfolded. Factors such as budget, available team time and energy, and the prevailing and often changing political directions would affect the degree to which these considerations could be addressed within the project. These points formed an initial framework for the inservice project; a framework the Science Team and I revisited and discussed many times as the project progressed.

Inservice: Where and When?

Formal inservice programming took place in June and August of 1991 at the University of Alberta in Edmonton, in June 1992 at the University of Lethbridge, and in June 1993 at the University of Calgary. These three Alberta universities all offer Bachelor of Education, Bachelor of Science and combined Bachelor of Education/Bachelor of Science degrees. It was hoped that collaboration on this project would increase the communication and cooperation regarding science education between Alberta Education and the Faculties of Education and/or Faculties of Science at each university. All three universities agreed to collaborate with Alberta Education on the field validation teacher inservice project; one university for each year of the field validation. Each university partnered in a different manner depending on where the interest and resources to assist in the project were coming from. At the University of Alberta and the University of Lethbridge the Faculties of Education were directly involved while at the University of Calgary the Faculty of Science became our closest partner. Teacher participants were fully accommodated on campus in residence buildings and provided with meals on site at all three universities. This was the best option for maximizing teacher networking opportunities and minimizing additional transportation needs and inservice costs.

With the original budget and resources available, I planned five days of field validation teacher inservice activity to be held before the field validation began, plus an additional one-day session (callback session) to be held in mid-January for each of the three field validation years. Such inservice activities would require the field validation teachers to be absent from their classrooms for six days a year in each of the three project years. Meetings were held with representatives of several participating school jurisdictions to determine the best time for the inservice activities within the school year. Taking teachers out of the school for this period of time would certainly be disruptive to student instruction and school routines. The objective was to find the least disruptive time period(s). The last week of June, just before the two-month summer break, and the first few days of school start-up in late August/early September were identified as the least disruptive possibilities. By late June, classroom instruction in senior high schools is generally complete and teachers are supervising and marking final examinations and determining final course marks. Although classroom teaching is complete, some students may seek individual assistance as they prepared for their final and diploma examinations. In the first few school start-up days in late August/early September, students are generally not present as the school staff prepares for the coming school year. In late June, other teachers available within the school could be called upon to cover the examination supervision and individual student pre-examination assistance normally provided by the field validation teachers. Substitute teachers would have to be brought in to cover only the examination supervision that could not be covered internally. No substitutes would be required for the late August/early September option as no students are present. In these two time periods, disruption to instruction/school routine and substitute teacher requirements were minimized. The cost of 90–125 substitute teachers for six days each year were prohibitive and if that cost was minimized the number of days of inservice activity Alberta Education could offer would be maximized. In the end, the only practical choice for both pedagogical and financial reasons was the end of June and late August/early September time periods.

In **Year One**, the inservice activities were split with a three-day inservice round in late June and two-day inservice round in late August. A one-day callback session was held in late January. In **Year Two** and **Year Three**, government budget cuts and fiscal restraint resulted in only four days of inservice being offered and plans for the callback session in each year being cancelled. In both **Year Two** and **Year Three**, inservice activity was consolidated into four day blocks offered in late June. This consolidation resulted in considerable savings, particularly for teacher transportation.

Valuing Teacher Expertise: Leadership Sharing

There was a strong recognition that the professional practices of the teachers as the field validation project began were generally very good and that they more than adequately met the needs of the science curriculum in place at that time. Prevailing teacher expertise was to be valued and built upon with any implication that their current practice was inadequate or disposable to be avoided. The professional challenge to the field validation teachers was that they determine what particular changes in their practice would be beneficial and possible in their classroom and to implement such changes. Alberta teachers were already practicing, to varying degrees, teaching and evaluation strategies supportive of the new program directions.

Based upon our own experience as classroom teachers and with teachers during the program development period, the Science Team believed that inservice leadership/facilitation by classroom teachers would be more effective in accomplishing program understanding and commitment than any further presentations by Alberta Education representatives. Teachers who were particularly strong in the areas of practice identified as important for successful implementation were invited to be leaders/facilitators for the various inservice workshops provided. Wherever possible, sessions were lead or jointly lead by practicing educators.

In all three years of the inservice project Alberta educators with expertise in various teaching and evaluation strategies and with strong facilitating and writing skills provided leadership for the inservice sessions. The Alberta Education leadership role was minimized by having their representatives minimize their leadership role in sessions, by having them play a joint leadership role with a classroom teacher(s) or by having them attend and participate at the inservice sessions alongside the field validation teachers. In **Year One**, such lead educators were identified in early 1991 and were offered a contract to carry out a three-fold task:

- to prepare and present a workshop session and supporting hand-out materials for the Science 10 field validation teachers
- to provide a written section on the same topic for the *Senior High Science Teacher Resource Manual* or the *Science 10 Teacher Resource Manual*. The tables of content for these two documents are presented in Appendix E
- to provide a clearly written workshop module on their particular topic. A descriptive list of these workshop modules is presented in Appendix E.

The contracted educators were required to write each workshop module in a manner that would allow any interested teacher to present a similar workshop with reference only to this module; e.g., overhead transparency masters and clear activity instructions included. The teacher resource manuals and the workshop modules were developed and field validated during the project and made available in final form to all teachers just before provincial implementation. These documents provided those teachers not involved in the field validation process with background information and a possible workshop experience similar to that offered to the field test teachers. The workshop module component was one I added to the project when some unexpected surplus funds became available at the end of the government's fiscal year in March 1991. Thirteen modules were developed on topics that closely paralleled those presented in the inservice activities and in the teacher resource manuals. Having the same lead educator develop all three components assured consistency across the components and resulted in efficiencies for me as manager of all three components.

In **Year 2** and **Year 3**, lead educators were contracted to develop and present inservice workshop sessions on various pertinent topics identified through the consideration of comments made by in the initial needs assessment and by field validation teachers' in their journals, during teleconferences and in informal teacher conversations with Science Team members. Where appropriate, these same educators were also invited to prepare materials for the next four teacher resource manuals in development to support the new Science 20–30, Biology 20–30, Chemistry 20–30 and Physics 20–30 programs.

Teachers as professionals and colleagues have much to offer one another. Opportunities for teachers to interact with one another, exchanging ideas and resources, and discussing experiences with the new program were considered very important to provide. Social and special events, some unscheduled evenings and meal times provided opportunities for such "networking" to occur. The Science Team had found in their own professional teaching experience, and from conversations with teachers during the curriculum development period, that it is often discussions outside the formal sessions that make a real difference in teachers attitudes and efforts regarding implementation of new curriculum.

Field Validation Teacher Questions

As the Science Team considered the needs assessment results, they anticipated that field validation teachers would have important questions about the project in seven major areas: roles and responsibilities, program rationale and philosophy, teacher science background, resources, teaching strategies, student assessment and evaluation and technology. The Science Team, through an ongoing process of discussion and drafting, developed a document on the roles and responsibilities of the field validation teachers and Alberta Education and also planned inservice session to specifically address the anticipated questions. These questions, presented in the following section under the area headings, would have to be addressed in initial and subsequent inservice activities. The answers to these questions or directions to sections dealing with the answers are provided in *italics* following each question.

Roles and Responsibilities
What is the role of Alberta Education? Who are the members of the Science Team and what leadership, support and resources will they provide?

The Alberta Education/Science Team Role is to:

- *provide project leadership, coordination and communication through the Science Team; a group of experienced science educators who have been closely involved in program development and who are prepared to assist and support you as you implement the new program over the three-year field validation period*
- *a clear and concise process for receiving ongoing feedback on the new program and resources*
- *teacher inservice programs throughout the project*

- *new program resources*:
  - *programs of study (official curriculum documents)*
  - *draft and test copies of basic student textbooks*
  - *teacher support materials (teacher's guides for basic student textbooks and draft teacher resource manuals).*

What is the role of the field validation teacher?

The Field Validation Teacher Role is to:

- *attend all inservice/callback sessions*
- *implement the new program in their classroom*
- *provide feedback to the Science Team regarding the new program of studies and the student and teacher resources, including the teacher resource manuals—submit all written evaluation forms and participate in teleconferences as required*
- *develop assessment and evaluation instruments for the new program and submit them to Alberta Education (voluntary—request only).*

Program/Philosophy and Rationale

Why was the program changed? What are the new program directions?

How will the new program be better for my students?

What is the depth and scope of the new program?

All inservice sessions will address the changes and new directions. Plenary sessions will provide Alberta Education's and teachers' views of the program changes and of how the program will impact students. The Vision Statement: Senior High Science Programs (Appendix G), also found on the first page of your Science 10 Program of Studies (Appendix G), provides a capsule summary of the program directions. Depth and scope beyond what is indicated in the draft program of studies will be clarified through the process of field validation with revisions to the programs made as required.

Teacher Background Knowledge

How does the teacher prepare to teach an interdisciplinary course when she or he has specific science discipline(s) education and experience?

Attend the various inservice activities planned and use the recommended teacher background resources. Special sessions to provide support for the new geology component of the new programs are being planned. Teachers with background and experience in different discipline areas within schools and between schools involved in the field validation have a great capability to help one another through a process of sharing their expertise. Inservice sessions are designed to encourage this "teachers helping teachers" aspect.

Resources

What student and teacher resources will be used in the field validation project?

What form will they be in? When will they be ready? When will we receive them?

All titles and publishers were listed on a sheet and placed in the inservice registration package. A draft copy of the custom-developed Visions 1 student textbook for Science 10 will be provided upon registration. A draft copy of the Senior High Science Teacher Resource Manual and Science 10 Teacher Resource Manual will also be provided. The required number of copies of a revised draft of Visions 1 will be delivered to schools in August, with a single copy of the student text and the field validation draft of the Visions 1 Teacher's Guide being delivered to your home address (if desired) at that time. In each field validation year, a copy of the draft or published resources will be available upon arrival at *the inservice with appropriate numbers of student copies and your personal copy of the Visions text and teacher' guide being delivered in August.*

Teaching Strategies
What teaching strategies are appropriate for the new program?
Do the strategies I currently find successful apply to the new programs?
Will we receive practical background and materials to support the implementation of appropriate strategies?

> *Teaching strategies will be addressed in the various plenary and workshop sessions of the inservice and in the materials provided by the workshop presenter. Further background will be provided in the various teacher resource manuals.*

Student Assessment and Evaluation
How are students to be assessed and evaluated? What is the evaluation framework?
What will be the impact of the new programs on the diploma examinations?
Will sample unit and final examinations be available?

> *The student assessment and evaluation strategies for the new senior high science curriculum will reflect the new program of studies. This calls for a broadening of strategies to include the science, technology and society objectives in the program and performance assessment. Suggested evaluation frameworks for the new courses will be provided at each major inservice session and workshops on student assessment and evaluation will be available. The suggested frameworks and the diploma examination swill be developed in consultation with teachers and will reflect the nature of the program. Unit and final examinations will be developed by teachers for teachers within the field validation project (later modified—see pp. 72–76 for details on how the assessment and evaluation component of the inservice unfolded).*

Technology
How does the new program address the integration of technology into my classroom practice? Will teachers see examples and have an opportunity to try out some appropriate technological strategies? Is extra funding available from Alberta Education?

> *Opportunities for such integration are numerous and technology integration is encouraged to whatever degree and level is possible within each individual school. Workshops addressing a variety of technologies and their use in the science classroom will be presented over the three years of inservice activity. The topic will be covered in teacher resource manuals and in an inservice workshop module. No extra funding for technology will be available to schools—schools will have to plan and budget for the introduction of technology they wish to introduce. Some schools have made technology a priority and are now well equipped, while others are just beginning to explore the possibilities.*

Initial Program Decisions

The Science Team and I wrestled with the question "Given the numerous changes in the new programs, what should be addressed in the first rounds of inservice?" The introductory round of inservice, the three days in late June, would have to provide the "big picture", concentrating on information and strategies that would be applicable across all of the new senior high science programs.

Considering the needs assessment information, the time and resources available, and the new program changes, we decided to focus on the following areas in the first round of inservice workshops and in the first two teacher resource manuals; teaching for thinking, STS teaching strategies, assessment and evaluation strategies, and the integration of library research skills and technology in the classroom.

In this first round of inservice activity the question was: How could we provide a general foundation for the whole senior high program while accommodating the teachers' expressed need for sessions directly applicable to what they would be teaching in September? In order to address both of these needs it was decided that the major directions and strategies applicable across the senior high science curriculum would be presented in a Science 10 context. Workshop presenters were required to use examples applicable to Science 10 so the sessions on strategies for teaching for thinking, STS, assessment and evaluation, library research and technology would be immediately relevant to the teachers.

The second inservice round, two days in late August, provided ten model hands-on activity stations for each of the four units of Science 10 in sessions jointly facilitated by an experienced teacher and an Alberta Education Science Team member. Sessions for general collaborative unit planning, one for each of the four units of the Science 10, were also provided. These sessions were also jointly facilitated by a teacher and a Science Team member. The **Year One** field validation teachers' inservice information letters with session descriptions, instructions to workshop facilitators and agendas for the initial inservice rounds held in June and August are presented in Appendix F.

Rationale and Philosophy

Teachers had been exposed to the new program directions over the five-year development period through presentation and discussion of the rationale and philosophy at various Alberta Education information sessions, professional development sessions and in several education related newsletters and magazines. The controversy surrounding the new programs led to various points of view being publicly and privately expressed, with some views being more informed than others. Although many teachers believed they had a good notion of the new program directions (they had heard enough!) there was still a need to provide a common baseline coverage of the program philosophy and rationale. A short and snappy initial plenary session to help build this common initial understanding was planned. It was decided that this would be accomplished by a two-pronged presentation; an Alberta Education program manager would speak about the development and components of the Senior High Science Program Vision Statement document presented in Appendix G, while two field validation teachers who had been involved in the development of the new programs would present their perceptions of the new science programs and what they would mean in relation to their professional practice. The initial plenary session would be followed with a variety of concurrent sessions to provide teachers with background information, practical suggestions and concrete examples of the new program directions in action, using Science 10 as a context.

Grouping Field Validation Teachers

To allow teachers to experience all the various sessions offered in the time available for the first two rounds of **Year One**, each teacher was assigned to a specific colour group indicated on their name tag by a coloured dot. A session rotation schedule based upon the colour group designation was provided so teachers could determine what workshop and room they should be at in during each session time period. The teachers were grouped for the first inservice round (June) in a manner that split up all individual school science staffs providing heterogeneous groups of teachers representative of the diversity of school environments in Alberta. This was done to provide a variety of perspectives in each workshop session and a mix of attitudes toward the new programs. The Science Team was aware that not all teachers/schools involved in the field validation had volunteered—some had been nominated by their school jurisdiction without consultation. Some groups of teachers were negative toward the new program, some very positive and some were reserving judgement. A staff block of teachers committed one way or the other was not seen as beneficial in any particular workshop session. In the second round (August), when unit planning and experience with sample hands-on activities for each unit were offered, the groups were once again struck in a manner that placed members of each school's science teaching staff in different planning groups. This provided greater opportunity for cross-pollination of ideas and teacher networking as general unit planning was in progress.

In **Year 2** and **Year 3**, much more teacher choice was provided. Teachers could select from a wide variety of afternoon workshops and could pre-register for the sessions they had chosen. School staffs or individual teachers could decide to attend certain sessions together or to split up and cover as many different sessions as possible. For the morning activity sessions in Year 2 and Year 3, teachers continued to be assigned to session sections. In these years, members of each individual school staff were assigned to the same group. for the morning activity sessions assuring they would have a common experience and be able to help one another and discuss how such activities could be implemented in their particular school setting.

The 20-level sciences (**Year Two**) inservice information package and the 30-level science (**Year Three**) inservice program information package are presented in Appendix F. The focus in these years was to provide teachers with opportunities to enrich their background in science, particularly in geology, while providing strong models of STS connections that could be used in the teaching of the new programs. Sessions on teaching strategies, such as cooperative learning and the broadening assessment and evaluation strategies, such as peer evaluation and skills assessment were also offered.

Student Evaluation and Assessment

Student Evaluation and Assessment was clearly identified in the needs assessment process as an extremely important issue for teachers. The teacher journal analysis later in this chapter shows that evaluation and assessment remained a concern of the field validation teachers over all three years of the project. Teachers wanted clear and concise direction on how student progress in the new senior high science program was to be measured and reported. What were the formal expectations associated with the new program and how would they differ from those being used for the old program?

At the time of the initial inservice session, June 1991, Alberta Education presented a draft model for assessment of the skills component for the new science programs (performance assessment) but at that time no final decisions as to the specific nature of the new 30-level sciences diploma examinations had been made. The performance assessment model would be further developed over the three-year field validation project with the assistance of the field validation teachers and the decisions regarding the diploma examinations were yet to be made. The diploma examinations would be developed and field validated with the help of the project teachers.

Nevertheless, the teachers were anxious to know what direction the diploma examinations would take—what type of examination would their students face at the end of the three-year field validation period?

School jurisdiction representatives, school administrators, parents, community members and the teachers place great importance on the Grade 12 diploma examination marks and the final blended mark results. These marks were seen as providing a yardstick for measuring the performance of not only students but also of teachers. Provincial averages were published and comparisons to individual school jurisdiction or school performance were drawn, often with no consideration of the variability within the learning environments or the student population. Diploma examination anxiety among teachers was understandable. Teachers felt considerable pressure to assure their students did well on the examination for two reasons; to maximize their students' future academic/job prospects and to demonstrate their own teaching competence.

The Performance Assessment Debate

In **Year One** and **Year Two** of the field validation project, there was much discussion of a possible 40%–40%–20% allocation for the final student marks in the 30-level (Grade 12) sciences; 40% teacher-awarded mark, 40% diploma examination and 20% on a performance assessment component. If such a change was to occur, would the teacher awarded performance assessment component be a teacher awarded component, a component administered by Alberta Education, or alternatively, be subject to sampling checks by Alberta Education? If 40–40–20 was to become a reality teachers were eager to use a similar framework for Science 10 and 20-level sciences to prepare their students for such a shift at the 30-level.

The lack of an early clear decision on the 40–40–20 issue made the field validation period a period of uncertainty with regard to the assessment and evaluation of the new programs causing uneasiness for both the inservice presenters and participants. Learning to live with uncertainty was part of the field validation process and was especially evident in the slow and politically influenced process that eventually lead to the decision that the components of a students final mark in a 30-level science course would remain the same—50% teacher-awarded/50% diploma examination to form the blended final mark. The additional resources Alberta Education would have required to do an adequate job of even monitoring a 20% teacher-awarded performance assessment component were simply not available. The costs for such a monitoring process were prohibitive, particularly in times of government budget restraint and cutbacks.

Although controversy swirled about what decision Alberta Education would eventually make for the final 30-level blended mark, the appropriateness of including a performance-based assessment reflective of the standard of skill development in the new programs was never in question. Alberta Education continued to encourage, support and collaborate with teachers as they attempted to develop and integrate an efficient and effective method for assessing the performance component in their classrooms. Models and samples for such assessment were discussed and included in inservice sessions and in the teacher support materials Alberta Education developed during and after the field validation period.

Skills Assessment Model Complements New Program Directions

A Model for the Assessment and Evaluation of Science Problem Solving Skills was developed by the Student Evaluation Branch in collaboration with a small committee of Alberta senior high science teachers who had a strong interest in this area. These teachers were not necessarily part of the field validation teacher cohort involved in the Curriculum Standards Branch's senior high science program field validation. The model, being very general in nature, was applicable to any secondary science program that involved a strong science skills component. The small group of teachers who worked on this committee, along with some additional volunteer teachers, worked closely with the Student Evaluation Branch to do initial field testing in their classrooms. This committee met regularly to make refinements based upon limited field testing to produce the first draft of the model and draft criteria provided to the larger group of field validation teachers who attended the inservice sessions. The first draft was provided to the field validation teachers in the initial round of the **Year One** inservice activities and was refined during the next two years as the committee of teachers and some additional volunteers, including a few field validation teachers, continued to field validate and refine the model in their classrooms. The involvement of a larger group of senior high science field validation teachers in this process included the Student Evaluation Branch inviting these teachers to use the model as a basis for the performance assessment component they were called upon to implement in association with the new program directions. Field validation teachers were encouraged to try the model in their classrooms with their comments regarding this model to be provided to the Student Evaluation Branch on a voluntary basis. Sessions involving the discussion of the evolving model were incorporated into each year's inservice sessions with revised updates being provided to field validation teachers at inservice sessions and through mailings to field validation schools during the school year. Formal feedback on this model was not a required part of the larger field validation project as the teachers in this project already had a large workload involving the validation of the new program and resources.

The model provided a problem-solving skills framework with the following six components:

- Initiating and Planning
- Collecting and Recording
- Organizing and Communicating
- Analyzing
- Connecting, Synthesizing, Integrating
- Evaluating the Process or Outcome.

A draft of criteria for assessing each of the six components to determine levels and an "Individual Student Profile" record sheet was included as part of the initial package. This package along with the other materials distributed in the Assessment and Evaluation workshops in the **Year One** sessions are presented in Appendix H.

As part of the **Year One** inservice a workshop on performance assessment was presented and complemented by sample performance activity stations and evaluation criteria for teachers to explore, critique and discuss. A workshop module on performance (skills) assessment in Science 10 was developed and made available to Alberta science teachers as part of the 13 module package described earlier.

Assessment Instrument Development Plan Revised

Teachers had indicated that sample unit and final examinations for all the new courses would be extremely helpful, especially if they were available before they had to implement these courses. Before the new curriculum had been field validated the appropriateness of the new curriculum content, depth and scope were still in question. At that time, there were no teachers that had classroom experience with the new program. With the Science 10, Science 20 and Science 30 courses, no textbook was available. A draft custom-developed textbook, to be field validated with the new program of studies, was available only a few months before the field validation began. Alberta Education took the position that development of assessment and evaluation instruments, with the exception of the diploma examinations, was the professional duty of the teacher. All these factors combined to make the development of sample tests before the field validation began an impossibility.

As the field validation project began, the Science Team intended to request copies of the various quizzes, laboratory tests and unit and final examinations that field validation teachers developed for Science 10 and later in Years Two and Three for the other courses. If the field validation teachers were willing to submit their instruments, collectively these would be used to develop a bank of appropriate questions, assignments, performance-based activities and unit and final examinations to accurately reflect the expectations of the new program. As it turned out, very few teachers submitted their assessment and evaluation instruments. The majority of those instruments that were received tended to be very traditional in format and did not reflect the new program directions to an acceptable degree. Teachers communicated to the Science Team through teleconferences and informal conversations that the volume of work associated with planning and delivering the new program, working with a new draft format resources and providing Alberta Education with ongoing feedback left little time and energy to develop high quality student assessment and evaluation instruments. As a result, teachers fell back on materials they had already developed or used longer written response questions they could generate quickly in order to "survive" the first time through the new programs. Teachers realized their assessment and evaluation instruments were not of high quality; they were not satisfied with the instruments they were using and were not prepared to share them until they had more time for development and refinement. Given that the field validation teachers were feeling such pressure in the first year of field validating the Science 10 course it was reasonable to assume the rest of the teachers in the province would experience a similar time and energy crunch when Science 10 and the other new courses were implemented provincially.

An Opportunity Arises

The Science Team agreed that a package of unit and final examinations with accompanying assessment criteria to model the expected level of student performance for each new course would be of great assistance to teachers implementing the new program but saw no practical way of developing these given the circumstances and resources available. About this time the political direction swung strongly toward the establishment of clear standards and accountability in education. This political climate coupled with the unexpected availability of some surplus funds at the end of the fiscal year in March 1991 and again in March 1992 provided the conditions needed to launch a project to develop such sample packages; packages first for Science 10 and in the next year for the four 20-level sciences. These packages would include multiple choice items, written response items and performance assessment items accompanied by marking keys and scoring guides/criteria and were to be developed in time for provincial implementation. Once the first semester of the Science 10 and later the 20-level Sciences field validation was complete (January) the Science Team would have a good sense of the revisions needed for the program(s) and the developing textbook(s). A cohort of teachers with field validation experience would be available for contract work on weekends and other experienced teachers could be invited to join the development group. The project ran from January through March each year and developed draft unit and final exams that were refined over the summer and available by September when the new courses were implemented. Although these packages were relatively rough and not field validated, teachers found them very useful as a starting point. Teachers did not have to start from scratch and were provided with an initial yet evolving model of the standard expected in the new courses. These examination packages were made available at cost in hard copy and on computer disk in various formats including a computer test-management program that was commonly used in the province (LXR–Test) through the Alberta Education Learning Resources Distributing Centre.

Diploma Examination Development

Resources and personnel were in place at Alberta Education to develop the 30-level diploma examinations for the new Biology 30, Chemistry 30, Physics 30 and Science 30 courses. Items were to be developed by teachers, particularly field validation teachers, during the summer break periods with the items being refined and pulled together into draft diploma examinations that would be field validated by the project teachers and their students. The best items from these drafts were to be used to form the first provincial diploma examinations. Although the field validation of the diploma examination would run only in **Year Three**, the development and critique of these diploma examinations were an additional workload for the field validation teachers in that year. On the other hand, the teachers were very interested in being involved to provide their expertise and influence to the development of the diploma examinations; examinations that would set the standard of graduation in each of the 30-level courses. The teachers involved would also have a first hand look at the direction and standards that were developing and viewed this as an opportunity to become familiar with and prepared for the nature and standards of the new diploma examinations in science a year or more before the examinations were provincially implemented.

In **Year Three** of the project, the final student mark for all the 30-level sciences was to be 100% teacher awarded. The teacher had the option of counting the draft diploma examination as little or as much as they felt appropriate. As Science 30 was a completely new course, an additional year where the teacher-awarded mark would be the final mark was allowed. In January 1996, the first official Science 30 diploma examination was administered and the final mark for students from then on was to be the blend of 50% teacher awarded mark/50% diploma examination mark, as it is with the other 30-level science courses. The fact that during the development/field validation year (two years for Science 30), the teacher-awarded mark would count as 100% of the final course mark was welcomed as a bonus by most teachers and students as it allowed for a year for transition. This concession was necessary as it is was impossible to make a fair examination on a whole course within the limited and hectic field validation time period—more field validation of the examination was required to assure the appropriate degree of validity and reliability.

Consultation/Communication Regarding Inservice Needs

Direct Discussion

Consultation and communication were primary considerations in the senior high science program development and implementation project. The Science Team was very aware that the best method of consultation and communication was direct discussion with the teachers. Whenever the Science Team had scheduled or informal meetings with teachers the opportunity would be taken to discuss what teachers felt they needed to implement the new programs, how the resources and inservice being provided were working and what new ideas for supporting implementation the teachers might have. The names, telephone and fax numbers for Science Team members were consistently provided with teachers being encouraged to contact the team with their questions, comments or ideas. Science Team members received numerous telephone calls and fax messages from teachers regarding various aspects of program and resource development as well as inservice and implementation activities. The various communications with the teachers were discussed among the Science Team and a response was always provided with appropriate action being taken whenever possible.

Information Packages/Publications

To supplement direct communication with teachers, implementation support packages, resource bulletins, suggestions for implementation, equipment lists and other support documents were developed, updated and distributed to schools and school jurisdictions. Additional copies were made available upon request from the Curriculum Standards Branch or the Regional Offices of Alberta Education. Alberta Education does not have access to a list of the teachers in the senior high science area and cannot mail these materials directly to the teachers. Instead, materials are sent to the school principals and the school jurisdiction superintendents with the request that they distribute them to their teachers. Unfortunately teachers do not always receive these materials, a definite weakness in the communication system. The problem of teachers not receiving important implementation information sent out from Alberta Education through principals and superintendents has not been solved. We continue to rely heavily on this method. It was determined through a survey that schools and school jurisdiction administrators can become overwhelmed at the combined volume and frequency of information packages arriving from Alberta Education and from other organizations. In response, materials are being bundled and mailing times have been standardized. School administrators and teachers can now anticipate and look for important information packages at set times of the school year. New curriculum implementation information from Alberta Education is “bundled” in a June package and the three major newsletters to the field—*Infocus*, *Connection* and the diploma examination bulletins are published and delivered on a regular schedule.

Field Validation School/Teacher Communication

Direct and efficient communication with the field validation contact teachers in the schools was maintained by fax and through the regular scheduled teleconferences. Each field validation school appointed a “contact teacher” for each semester of the field validation. The contact teacher received, gathered and/or distributed information as required. They also represented their school in several rounds of teleconferences that were held during the project—approximately four rounds per school year, two per semester. Teleconferences provided a economical and effective method of contact with the field validation schools. Teachers and the

Science Team were able to discuss and often resolve the many issues arising during the field validation period. Teleconferences provided supportive links between teachers in different schools. Faxes were used to distribute the teleconference schedules, protocols and agendas. Contact teachers who had questions or who required a shift to another teleconference date contacted us by fax or telephone. Teleconferences involved 8 to 10 field validation teachers and at least two Alberta Education science team members, one as the teleconference facilitator and one as the recorder. Generally teleconferences lasted 1–1 1/2 hours, running from 3:30 to 5:00 PM with Tuesday, Wednesday and Thursdays being the preferred days. The faxed agendas were followed rather closely to assure all important points were covered, yet participating teachers were provided with ample opportunity to network with one another, to share their feelings and experiences of the new programs and offer help and suggestions to one another. The formal written record of these teleconferences were extremely useful to the Science Team as they worked on program revisions, resource development and identification and the inservice and implementation support planning. A sample teleconference schedule is presented in Appendix I.

Science Team Communication

The Alberta Education Science Team was a very cohesive unit, communicating formally and informally on all aspects of the program development and implementation. Regular meetings were scheduled for team information sharing and planning based upon the input from field validation teachers. Close communication within the team assured members were "up to speed" on current developments within the project. Team members participated in several aspects of the project in addition to the ones they were directly responsible for. For example, I would seek and receive input on the planning of inservice activities, be updated on program and resource development, and be consulted on specific aspects of the program or resource development where I had appropriate background or experience. This team approach, the continuous collaboration, strengthened the team's ability to provide consistent and high quality leadership and resulted in a more coordinated and consultative curriculum and resource development process within the project. Close and open communication within the team provided a good foundation for clear, consistent and open communication with the teachers and other science education stakeholders. A summary of the communication modes and opportunities used to support the implementation of the new science programs along with some samples of key communication documents are presented in Appendix I. The three inservice information packages sent to teachers in Year 1, Year 2 and Year 3 are presented in Appendix F. These packages provide the letters, inservice schedules and information that gave teachers an overview of the planned program for each year.

Teacher Recognition

I have always been a great believer in positive effects of recognition of effort and accomplishment as I know it works for me. A few words of encouragement and appreciation can keep you going through very hard times. The field validation project was going to be extremely hard work for the teachers involved and I was committed to recognize their efforts formally at the inservice sessions and through formal and informal communications as the project unfolded. Alberta Education seemed paralyzed in respect to making a decision on the format of formal recognition certificates which the Science Team and I had decided would be presented to all teachers at the end of each field validation year. Apparently, the certificate would have to be standardized and approved for use across all subject areas and efforts to do that previously had floundered. In the meantime, no formal certificate format existed so no certificates from Alberta

Education were being issued. As we could get no decision a computer graphic literate Team member worked to design and produce certificates that were presented to teachers at the inservice each year. These certificates were from the Science Team with each members signature appearing. They were presented in the last plenary session of the **Year Two** (Science 10 completion) and **Year Three** (20-level sciences completion) inservice sessions and mailed with a letter to teachers after the completion of the 30-level field validation year. The presentations at the inservice plenary sessions involved all members of the Science Team shaking hands and informally conversing with each teacher as they were called to the front to receive their certificate. Teachers were also recognized and thanked for their efforts in the project newsletters, in Field Validation Reports sent to schools and in teleconferences, provincial information sessions and the Alberta Teachers' Association Science Council newsletter, *The Science Teacher*. Science Team members were always diligent in sincerely thanking teachers for their efforts on every aspect of the field validation process; from response guide submission to participation in development of suitable evaluation items. I believe the recognition of teachers for their efforts as professionals had a positive effect on the project—it provided a tangible demonstration of appreciation that contributed to the generally positive attitude teachers had toward project participation.

Field Validation Teacher Journals: A Powerful Evaluation Tool

As I began planning the first three-day inservice session for field validation teachers in Year 1, I searched for a way to determine how teachers were feeling about their involvement in this project; how they viewed the new curricular changes and what they thought they needed to help them implement the new programs. I also needed specific feedback on how each individual inservice session was received by teachers. Such information would allow future inservice planning to build on the strengths identified and improve in the areas where teachers indicated weaknesses. Traditional session evaluation checklists or directed comment sheets would not provide the depth of response I was seeking. I had recently attended a workshop given by David Blades on "*Teaching for Thinking*". He had provided a single page session evaluation form composed of several nearly blank rectangular boxes, each with a few lead-in words to get you started and room within the box to hold your completion of the lead-in statements. Sample lead-in statements from the single page form were:

> I enjoyed . . . /I want to . . . /If I were running this session I would . . .

I found the box completion format inviting and I easily wrote down my feelings and ideas given the freedom and yet general focus of the format. It was a nice transitional format—somewhere between structured and technical evaluation forms and those that are completely open and unstructured. I adapted this format into the teacher inservice session "journals". Although not really a true form of journal writing, "journal" was the term we used to describe this record of teacher thoughts and perceptions focused by the stems and the size of the boxes. The small box completion format with only the lead-in statements varying from session to session worked well in the **Year One** of inservice held for Science 10 in June and August 1991 and was used again for the next two sessions in the summers of 1992 and 1993. Photo reduced copies of the **Year One** (Science 10) inservice journal form used with participants to evaluate the field validation teacher inservice sessions are presented in Appendix A. Complete samples of the **Year Two** and **Year Three** journals have not been presented as these journals used the same format with only the courses being considered and the inservice session titles changing.

The Science Team and I discussed the format and the manner in which the journal writing process could be implemented with the teachers. It was decided that the first ten minutes of the first plenary session would be designated for teachers to fill in the first page of their journals, the *Initial Perceptions* page, with suitable background music provided. At each of the following inservice workshops the facilitator(s) would allow the last ten minutes of the session for teachers to reflect and fill in the journal page as an evaluation of that particular session. The journals would remain with the teachers over the inservice period to be collected at the last plenary session or alternatively mailed in later, as the teacher preferred. Journals could be worked on out of session time or after the inservice was over if additional time for reflection was desired. Submission of journals and inclusion of name were to be optional, although both were encouraged to assist future inservice planning and allow a more immediate and personal response to concerns or questions we felt we could immediately address.

I anticipated the following challenges as I planned the introduction of this modified form of journal writing to the group of senior high science field validation teachers:

- this technique would be new to most teachers
- the journal writing process could be viewed as taking away valuable inservice time for an exercise of uncertain value
- several teachers may not respond or choose not to hand in their completed journals—the risk of having a small sample of evaluative data was real
- development of teacher trust that Alberta Education would use the information they provided in a constructive manner—anonymity, if desired, would be essential
- providing satisfactory answers to teachers questions regarding what was to be done with the information
- direct and personal response to each individual would be impossible, however, on the basis of teachers comments, we could judge, and where appropriate and possible, make changes to future inservice activities.

With hopes of obtaining information useful to responsive inservice planning, the risk of a possible low response rate and/or negative reaction was taken. The success of this venture would be judged quickly from the teacher reaction when the journal writing activity was introduced. A quick shift to a more traditional evaluation form could be made if necessary. I reasoned that if in the first plenary session teachers did not object and actually wrote in the time allowed then they would continue to do so in successive sessions, finally submitting their journals at the end of the inservice round.

In initial and subsequent rounds using this journal writing method to check participant perceptions and to provide session evaluation proved effective. Important factors in the success of this venture were:

- the purpose of the journals—to improve inservice quality and teacher support—was clearly explained with examples of possible effects of journal comments on inservice structure were provided
- the format was "user friendly", could be completed quickly and easily, yet flexible for those who wanted to say more than the boxes allowed (back of pages left blank for more extensive responses)

- inservice session facilitators consistently provided ten minutes at the end of their sessions for journal completion
- completion and submission of journals was promoted in formal sessions and informal conversations with teachers but not the point of "nagging"
- flexibility was stressed—journals could be mailed in later or an alternative feedback method such as a letter or speaking directly to Science Team members was suggested (we did receive some letters and many direct verbal comments from teachers).

The manner in which the journal writing process was introduced to teachers was critical. Trust that the information provided would be put to good use was essential. The initial response from teachers to the request for them to "journal" was positive with 84 journals of a potential 88 journals being completed and turned in during the first inservice round in June. Teachers appreciated the changes that were made in the following rounds of inservice in response to their comments and trust in the journal writing process built. The journal comments over the next three years became more open, more specific and more extensive as the Science Team's responsiveness to expressed concerns became evident.

In each of the three years of inservice all the teachers comments for each journal section and/or inservice session activity were entered and a synthesis document produced. Each recorded comment was referenced to the particular journal page and the specific lead-in statement it was associated with. The intention of the recording of comments was to provide immediate and useful feedback; feedback to inform the planning of the next round of inservice activity.

In **Year One**, journal comments were entered by school with no names being recorded. The entries for specific pages and lead-in statements were clustered in school groups to provide a profile of the teachers within each school. Such a grouping provided information useful in making decisions on how to more effectively engage and group teachers for future inservice activities; it helped determine if there were any prevailing attitudes, issues, strengths or weaknesses within any particular school group. In **Year Two**, comments were entered with no school or teacher name recorded—each participants' journal was assigned an identity number and the comments from each specific section of the journal were grouped together. In **Year Three**, both the name and school were identified in the recorded comments if this information had been provided.

As I read each journal before submitting it for computer input, I was struck with the diversity of perspectives expressed in the teachers' comments; by the variety of ideas and expectations expressed, particularly in **Year One**. As shown in the analysis that follows, the comments reflected large differences in teachers' attitudes toward the new programs and the field validation project, in their confidence regarding the teaching of the new programs and in their expectations of the inservice sessions. Attempting to address these diverse needs and expectations was the challenge we faced.

A printout of all the teachers' journal comments was provided to each member of the Science Team. No formal analysis beyond the entry and Science Team consideration and discussion of the comments was undertaken at that time. Comments provided by teachers in the *Initial Perceptions* section and in all the other sections of the journal were used to inform not only inservice planning but curriculum development, resource development, resource identification and communication strategies for the project.

Perspective Two: Teacher Participant Reflections

The teacher participant perspective is presented as an analysis and discussion of teacher comments made on the *Initial Perceptions* page, the first page of the field validation teachers' journals. Time to complete the *Initial Perceptions* section of the journals was provided in the first plenary session of each round of inservice, in June 1991, 1992 and 1993. Teachers, in most cases, completed the lead-in statements before they actually began their inservice experience.

I designed this first journal page to provide information on how teachers felt about being involved in the project, on their perceptions of the new science programs, on their expectations of the upcoming inservice activities, and on how they saw their involvement in these sessions relating to their classroom practice. The five lead-in statements on this *Initial Perceptions* page that were used in the first and the next two rounds of inservice are presented in Table 5.1. A general statement regarding what each particular lead-in statement would most likely lead teachers to comment on is presented in the second column of the table. These "expected information" statements will be used along with the lead-in statements as headings for the graphical presentation of the journal data analysis for each of the three years of the project.

Table 5.1: Teacher Journal Lead–In Statements and Type of Information Expected

Journal Lead-In Statement	Expected Information
I am feeling . . .	Teachers' Affective State
I want to know . . .	Teachers' Specific Questions/Concerns
I expect these workshops to . . .	Teachers' Inservice Session Expectations
Science 10 will . . . *The 20-level sciences will . . .* *The 30-level sciences will . . .*	Teachers' Expectations of New Course(s)
My students will . . .	Teachers' Rating of New Program Potential for Students

The *Initial Perceptions* page in the **Year Two** and **Year Three** inservice participants journals was basically the same as in the Science 10 **Year One** sample and samples of this page for each year are presented in Appendix A. The only difference from year to year was that the course(s) designated in the lead-in statement, *Science 10 will . . .*, changed to *The 20-level science courses will . . .* in **Year Two** and *The 30-level science courses will . . .* in **Year Three**. Following the *Initial Perceptions* page, the participant journals provided one page for each workshop session the teachers attended in that particular round of inservice. The six boxes provided on each page presented the following lead-in statements:

Teaching for Thinking (or specific title of each workshop) is . . .
This workshop was . . .
I would like to know more about . . .
My students will . . .
I intend to follow-up by . . .
If I were running these sessions I would . . .

In considering the complete set of journal comments for each specific workshop the Science Team was able to determine things such as: Did the session accomplish what we had thought it might? Is a follow-up session needed? Should we use these facilitators for future sessions? How can we build on the strengths and work to remedy the weaknesses? How did teachers see the session relating to their students and their own practice? The journal comments worked well in this respect, providing us with information that allowed for responsive planning for the next sessions. The synthesis of the participants' journal comments on each specific inservice workshop were sent to the presenter(s) providing them with the details of participant reaction to their particular session; information useful to them should they be presenting a similar session in the future.

Although all comments for each specific inservice workshop/session for all three years were recorded and considered in inservice planning, specific analysis for my research purposes was undertaken only for the first page of the journals, the *Initial Perceptions* section. Where possible, I have limited my analysis of the *Initial Perceptions* journal comments to those of the field validation teachers and have not considered the comments of several representatives of Alberta Education, school jurisdictions or universities who attended the inservice sessions and submitted journals. In **Year Two** no names or schools/affiliations of the journal respondents were recorded so I had to consider all comments unless it was obvious that particular comments were not made by a classroom teacher.

As I initially examined the teachers comments I recalled personal conversations held with teachers, the looks on their faces as I spoke to them in formal plenary sessions, the varied responses to the soft music and journal writing opportunity, and the changes in individual attitudes as the sessions unfolded. Such memories along with several readings of the journal comments helped the Science Team and me plan in a responsive manner for each successive round of inservice activity. When I later returned to these comments to formally analyze them for this research the same memories helped me establish the categories I used for describing and considering the teachers' journal comments. The categories are not identical from year to year as the nature of the comments changed necessitating changes in categories. In several cases diverse comments that did not fit into one of the previously established categories were placed in a miscellaneous bin entitled *other*. Although diverse, some very important comments fell into this *other* category.

Teachers made comments varying in length from a short and simple phrase to several sentences. As a result, within one teacher's entry I could find comments that fell into two or more categories. This explains why the number of comments categorized can exceed the number of journals submitted. In the sample comment sections for each category, comments that were close in meaning or closely related are grouped together, separated by a backslash (/). This method allows a more extensive sample to be shown in a given space and demonstrates how different teachers expressed related ideas.

Teachers' completed comments for each of the five lead-in statement sections of the *Initial Perceptions* page were considered separately resulting in five groups of data for each of the three years of inservice activity. The comments within each lead-in statement section were tallied and carefully considered before the comment categories for each section were established. Each comment within the section was then placed into one of the established categories followed by a tally of comments falling into each category being taken. The percentage of comments falling within each category was calculated with the results being shown on a bar graph developed for each lead-in statement section (5 graphs per inservice year/15 graphs in total). Each bar graph shows at a glance the categories established and the relative percentage of comments in each category. Following the bar graph, a sample comment table demonstrates the nature of the comment placed in each category. Together, the graphs and comment sample tables provide a data summary and a springboard for the various discussion sections that carry the story of **Year One**, **Year Two** and **Year Three** of the inservice project forward.

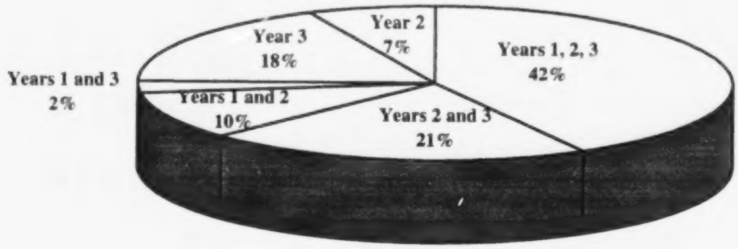
Demographics

In **Year 1**, although we encouraged all senior high science teachers at each school to attend the inservice sessions, many schools sent only the teachers who were slated to teach Science 10. In **Year 2**, the numbers of teachers attending jumped considerably as the Science 20, Chemistry 20, Physics 20 and Biology 20 teachers were added to those who had already taught Science 10. In **Year 2** and in **Year 3**, almost full science staff attendance from each participating school was attained. The following chart indicates the number of teachers attending each year and the percentage of teacher journals submitted in each year. In **Year Two**, two Francophone school jurisdictions, one separate school jurisdiction and one private school jurisdiction, were added to the project.

Table 5.2: Teacher Participant Numbers and Journal Submission Information

Year	Teacher Participants	Number of Teacher Journals Submitted	Journal Submission Percentage
1	88	84	95%
2	119	83	70%
3	134	90	67%

Figure 5.1: **Percentage of Teachers Attending Inservice Sessions in Specific Years**



Some teachers attended all three years of inservice activity while others attended two years or one year. The majority attended all three years with the next largest group being those that joined the project in **Year Two**, attending in Years Two and Three.

Year One *Personal Journal* Analysis

Science 10 Inservice Sessions
June 24, 25, 26 and August 29 and 30, 1991

The initial inservice activities in **Year One** were split into two rounds; 3 days in late June and 2 days in late August. One personal journal was provided to each inservice participant for the purpose of recording their perceptions for both the June and August inservice segments in **Year One**. The *Initial Perceptions* page, the subject of this analysis, was completed by field validation project teachers at the first plenary session in June, generally before they had experienced any of the formal components of the planned inservice activity program. Thus, these comments provide a window on the teachers' feelings and expectations before the project formally began.

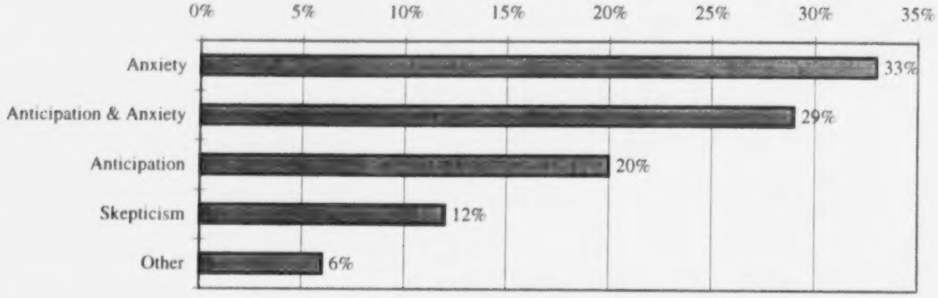


Figure 5.2:
Year One—Teachers' Affective State
Percentage of Teacher Journal Comments by Category
I am feeling...

Sample Comments (81 comments were categorized and considered)

Anxiety—33%

- apprehensive about teaching general science because I have specialized for many years. I am feeling dubious about teaching students how to think and testing them in this manner - the idea is valid; however, the universities and technical schools require content. Why are we starting at the bottom instead of the top? (universities)
- very down! I don't see a lot of material that I can use in the classroom. When I think of a teacher resource manual I think of the chemistry STSC resource manual. Everything is so abstract! Give me something concrete and I can bring it to life; confused—all this paper, is it really essential?
- coffee would have been nice; that I don't know what the main focus or idea is of the new course; that I want to hear what my fellow teachers have to say about this course.

Anticipation and Anxiety—29%

- overwhelmed, optimistic/exhilarated but somewhat apprehensive; it appears to be a monumental task at the moment
- interested; concerned about the new program; excited to be here with new faces (and a few familiar ones); excited at the idea of making new "contacts" to shared resources and ideas with; concerned regarding class sizes and the necessary "hands on" involvement of students.

Anticipation—20%

- an expectation of success because of the amount of obvious commitment to the new program
- optimistic about the new science curriculum; hopeful that the sessions will be practical; impressed with the organization put into the workshops
- that this is a very worthwhile experience; enthusiastic.

Skepticism—12%

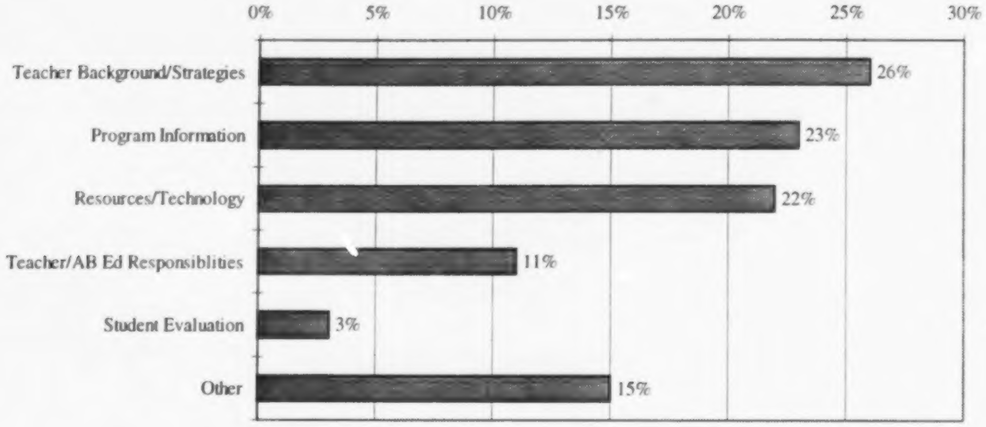
- skeptical, that an alteration of curriculum will achieve the expressed goals; more attention has to be paid to public attitudes to education!
- I like the course but just hope the resources will be available in time to adequately prepare for the course, i.e., texts, examination banks, resources

- I was expecting sessions on lesson and unit planning and content specific sessions.
Other—6% - indifferent/doubtful at this early hour of the morning - enjoyed very much the trip up on the airbus; organization and registration were well done; my initial euphoria was dampened significantly upon entering my room—no TV, no telephone, dirty rooms—not impressed at all!

Comments in this section reflected varying degrees of anticipation, anxiety and skepticism as teachers faced their first inservice session, a yet unknown quantity. This is not surprising as they faced the implementation of a major curriculum change with several new and demanding directions. They had yet to be given specific information on their role as a field validation teacher or on the resources available to them. The Alberta Education Science Team had just been introduced to them as this was the first formal event of the three-year field validation project. Trust and collegiality within the project needed time and opportunity to develop. Some teachers expressed anticipation of the opportunity to meet with other teachers to share ideas, resources and experiences. A desire for more content specific sessions than the published inservice agenda reflected was expressed in several teacher comments.

The average age of an Alberta teacher at the time was approximately 43 years. A large percentage of our field validation teachers were this age or older, veteran educators who were used to a higher level of creature comfort than the dormitory accommodations provided. The student residences they were housed in were older and rather Spartan with group washrooms on each floor, and reportedly not clean or well maintained. "Roughing it" in dormitories was for several teachers an added negative to be overcome just as the field validation process began with the first inservice activities. We used the same accommodation again in August in spite of the numerous complaints as the meal and accommodation arrangements for both June and August had been negotiated as a package—the reasonable cost and convenient location could not be matched. For the August session, we offered teachers credit equal to the cost of the dormitory accommodation if they wished to make alternative arrangements and pay the difference themselves. A few teachers who found the accommodation particularly unsatisfactory chose this route but most chose to remain with their colleagues, save their money and benefit from the many networking opportunities the on-campus residence provided.

Figure 5.3:
Year One—Teachers' Specific Questions/Concerns
Percentage of Teacher Journal Comments by Category
I want to know…



Sample Comments (161 comments were categorized and considered)

Teacher Background/Strategies—26%
- how to make science more exciting and acceptable for a broader range of students
- strategies to support an integrative, holistic approach to course and more thoughtfulness and creativity in students/shifting from teacher centered to student centered approach/ what about cooperative learning
- balance between STS and knowledge component/how to integrate content, skills and STS/how STS can be practically infused
- background in the Science 10 areas out of my area of discipline expertise/a short course in meteorology would be beneficial
- how this inservice will help me teach Science 10/ how to interest and motivate students in Science 10
- the practical nuts and bolts needed to make the program work/how to carry out the day to day planning and implementing of this course/specific content for units
- how to prepare lab kits for individual learning/the required investigations.

Program Information—23%
- why were these new courses developed/how to answer students who ask "why am I taking this?"
- what is the balance between knowledge, content and skills
- the order of units in program/connections between units/the exact sequence of concepts
- unit weightings/timelines for unit presentation/is there an elective portion
- relationship of the new senior high program to the junior high program
- why when other countries emphasize content and expertise, we de-emphasize it.

Resources/Technology—22%

- availability and quality of student and teacher resources/will the resources be ready in time
- final full colour version of text would have been preferred to draft/why was student text not completely written, field tested and revised so an excellent resource was available to back up what should be an excellent program
- how do I cope if I am computer illiterate
- about the use of computer technology and instruments in the classroom/how to integrate telecommunication technology in the classroom.

Teacher and Alberta Education Responsibilities—11%

- the nature of program and resource feedback expected/the format it will take
- what is the time commitment involved/the amount of time feedback will take
- what is my role in the course revision process/will my input be taken seriously
- what compensation will there be to teachers for additional work involved in preparation
- how is AB Ed going to help.

Student Evaluation—3%

- how will the new programs be evaluated when the content seems so open ended/will skills and attitudes be evaluated? How?
- how to develop an effective evaluation program to test student skills, concepts etc. that won't be a huge burden on me
- knowledge that evaluation will be meaningful and not done simply for evaluation's sake
- availability of unit and final tests, item banks/will exams be supplied or can we work together to create them
- diploma examination directions/can we get rid of diploma exams so we can feel more comfortable with less emphasis on content
- will jurisdiction administrators be informed about the relative importance of diploma examination results compared with actual student learning and experience.

Other—15% (funding/accommodation/post-secondary acceptance/miscellaneous)

- will these new programs, particularly Science 30, receive post-secondary acceptance and support
- why were sessions held in the diploma examination week in June?
- how, or if, Science 10-20-30 is an improvement over present existing courses
- how science is going to be made more acceptable and exciting to a wider range of kids
- availability of additional funding for schools/are there funds for each school? I know that some schools have already received funds/who pays for computer networking/how I'm going to convince my principal I need $5000 for new equipment
- why were we accommodated in such poor quality rooms (Lister Hall).

Teachers had indicated they expected inservice experiences that addressed the specific content of Science 10, the depth and scope of the program, appropriate teaching strategies, the availability and content of student and teacher resources and appropriate training and background on technology. The roles and responsibilities of field validation teachers and of Alberta Education within the project were questioned. All these items were to be addressed in this first round of inservice activity and built upon in the two days of inservice in late August.

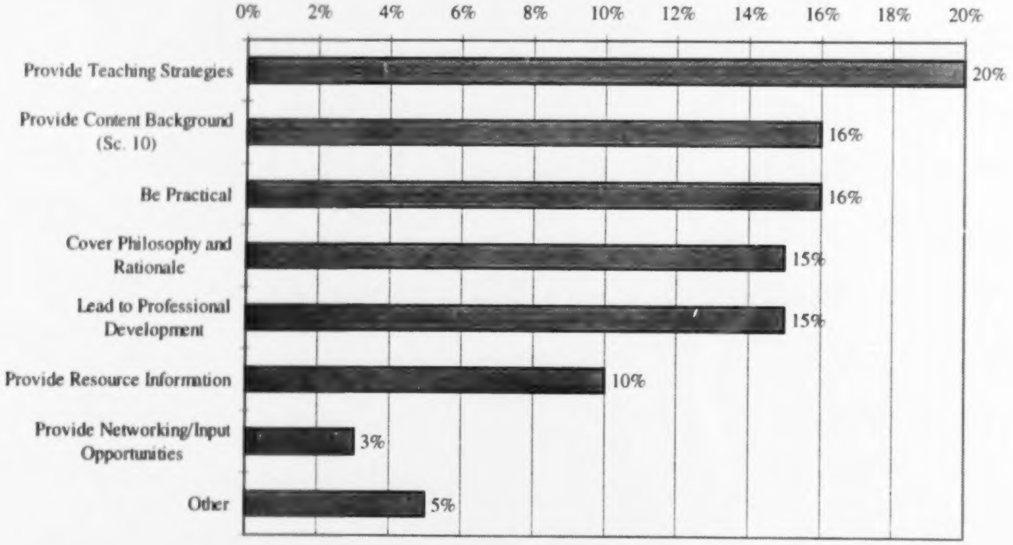
Reference to practical, "hands on" or concrete activities, an appeal for basic information and skills directly applicable to the classroom, was evident. These comments reinforced the Science

Team's belief that providing practical strategies in a teacher interactive environment was an effective method to support teachers implementing the new program. It had been decided that the next round of inservice in August would focus on unit planning and appropriate hands-on activities for the four units of the new Science 10 course. Details of how this was to be done had not yet been worked out. The information provided by teachers in this section affirmed the importance of the teachers actively planning, participating and interacting to gain skill, confidence and expertise to use in their Science 10 classrooms.

In the "other" category a few teachers began to express a need for specifics regarding student evaluation. Several more questioned the availability of funding to provide facilities and equipment for schools implementing the new science programs. The questions regarding funding were addressed immediately in plenary sessions. The answer provided was that the Secondary Education Implementation Credit Allocation Grant (SEICAG) would likely continue on for each year of implementation of the new senior high science programs as it had for the implementation of the other new secondary programs. This grant was approximately $7 per pupil toward teacher professional development activities and approximately $14 credit per pupil at the Learning Resources Distributing Centre to be used for any new authorized student textbooks. The grant could be used for any new secondary school program and was not tied specifically to the new science program. A few additional comments regarding the poor quality accommodation were also registered.

The new science program rationale and philosophy was mentioned by only 5% of teachers in this section. Although this was not a top priority for teachers in the **I want to know**. . . section of the journals, it showed up quite strongly in the next section.

Figure 5.4:
Year One—Teachers' Inservice Session Expectations
Percentage of Teacher Journal Comments by Category
I expect these workshops to...



Sample Comments (161 comments were categorized and considered)

Provide Teaching Strategies—20%
- provide me with some good teaching strategies/tell me and show me new teaching strategies/demonstrate teaching strategies for Science 10
- give me some good solid hands on activities for implementing this course/provide hands on activities that will enhance my teaching

Provide Content Background (Science 10)—16%
- help me focus on our new science program outcomes and expectations
- clarify the content/process concerns I have
- give specific information on course content/indication of depth.

Be Practical—16%
- provide practical information and methodology
- provide me with useful, meaningful, relevant information and hands-on experience
- basic survival instructions/I want materials I can use or modify for immediate classroom application.

Cover Philosophy and Rationale—15%
- give me a framework to understand the concept of Science 10-20-30, where it fits into the senior high science program
- give me some confidence in the course; that the change of program is the right thing for students
- familiarize me with Science 10 goals

Lead to Professional Development (general statements, willingness to grow)—15%
- provide inspiration and the seeds of new methods which I will be able to develop over the course of Science 10
- assist me in my quest of re-education/provide innovative and new ideas/give me some ideas to expand and develop on/enlighten, enrich, empower, enthuse
- relieve my anxiety and prepare me in such a way that the upcoming year will be an enjoyable and satisfying experience.

Provide Resource Information—10%
- give me a better idea of what resources will be provided and when they will be available
- introduce materials/provide me with resources to help institute these programs/a look at the textbook, resource materials/I want materials that I can use.

Provide Networking/Input Opportunities—3%
- help me focus my thinking because I will experience others' interpretations of this program; then I hope to synthesize these ideas with my own
- give me an idea of what my professional colleagues are doing in this area/provide opportunity to share ideas/introduction to new teachers and line of sharing
- to allow input of the teachers concerned.

Other—5%
- I hope to gain some insight in evaluating and testing in this program
- be of little use. I am skeptical that inservices will provide any solid assistance to my plans for next year/I do not want them to be a sales job for the course
- provide areas of problems that we will be able to troubleshoot once pointed out
- make up for the uncomfortable room arrangements.

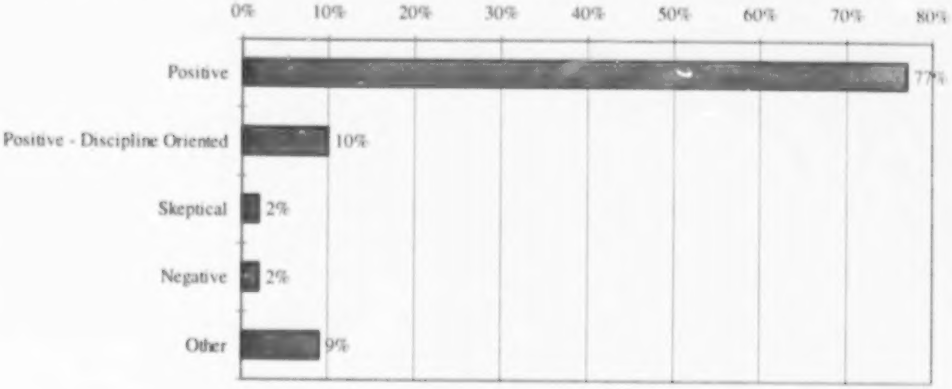
Provision of practical information and experience on teaching strategies, program content, program philosophy and rationale, and quality professional development opportunities were the teachers' major expectations. In a variety of ways teachers expressed a need to understand why the changes had occurred, what were major directions within the new programs and why were these particular directions chosen (Rationale and Philosophy). Student and teacher resource information and materials were also expected. Some reference to providing teacher networking opportunities and specific information on evaluation and testing was made. Once again a few comments expressing dissatisfaction with the accommodation appeared.

The three journal sections just reviewed, the *I am feeling. . . , I want to know. . .* and *I expect these workshops to. . .* all reveal a very real teacher concern regarding a lack of background in various science areas that they had very little experience with and with the availability and nature of the students and resources. Several teachers expressed doubts that indicated a low personal confidence level as they faced the implementation of Science 10 only two months in the future.

The next two journal sections to be considered, *Science 10 will. . .* and *My students will. . . ,* reveal these same teachers' hopes for the new program. A different tone prevails as most teachers project past the anxiety and struggle of initial implementation and look ahead, envisioning the program fully implemented and running smoothly. It is in these comments that a considerable understanding of the new program directions and support for these directions emerge. A shift in tone from varying degrees of fear of the unknown, lack of confidence and need for adequate support resources to a more positive, optimistic and confident tone is quite noticeable.

In both the *My students will. . .* section above and the *Science 10 will. . .* section that follows the same categories for classification emerged and worked well.

Figure 5.5:
Year One—Teachers' Expectations of New Course(s)
Percentage of Teacher Journal Comments by Category
Science 10 will...



Sample Comments (81 comments were categorized and considered)

Positive—77%

- produce the greatest change in philosophy and mode of science education that has occurred in Alberta in the past 25 years
- provide more of an opportunity for students to develop their thinking skills because it avoids the narrow delineation of the separate Bio 10/Chem 10/Physics 10 courses
- expand my horizons/be futuristic/probably be a refreshing change
- provide an opportunity for student input; investigate areas of everyday concern; perhaps change way of thinking in the young people/relate science, technology and society/generate enthusiasm in students and teachers for science; bring science into people's daily lives
- provide more hands-on materials and projects; more chance for research and discussion; be more student centered
- be a successful course that students enjoy and as a result want more of the same and therefore continue with Science 20 and 30
- be a more interesting and practical course; put the zip back in science
- give students a broader understanding of the concepts involved in science and changing technology; prepare students for higher level science courses in high school; introduce students to a variety of career choices in the scientific field.

Positive - Discipline Oriented—10%

- give students a better understanding of the three science divisions before deciding on a specialty course/give many students a chance to sample information from all three science areas; a taste of all three disciplines/be a good introduction to Biology, Chemistry, Physics.

Skeptical—2%
- fly, however, I am concerned about whether it will accomplish what it preports to do
- time constraints: is there enough time to complete the course?
- delay the exposure of students to in-depth science until their Grade 11 year; it seems to rehash junior high all over again: however, hopefully, it will provide more relevant and interesting hands-on activity oriented science for students.

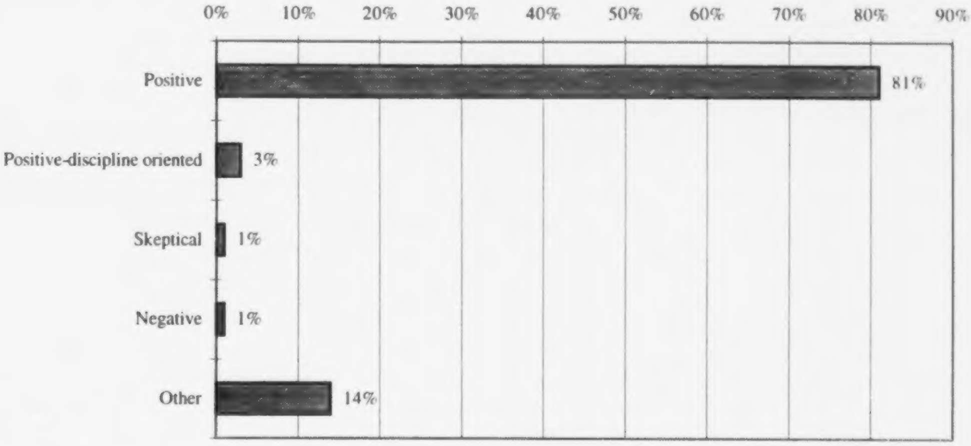
Negative—2%
- not make a significant change in the number of people that are entering science or even becoming scientifically literate
- be a burden to start; be a setback to science education because I feel that it's just another general course like the junior high science.

Other—9%
- require a lot of organization and planning. A lot of time will be required to get set up for September
- succeed or fail depending upon the success of the workshops. The Department of Education has obviously spent a lot of time, money and consideration in implementing the new program
- compete with Biology, Chemistry and Physics for resources and teachers/replace Biology, Physics and Chemistry 10
- create problems of standard setting for me, in this pilot year
- make it or break it on the strength of its first couple of years.

Within the group of positive comments some of those that were positive in tone took on a decidedly "discipline science" slant regarding a new program, a program that aimed to integrate the discipline sciences to a much greater degree. This was an indication that the idea of an "integrated" science program was not totally understood and/or accepted by a substantial number of teachers. In the much smaller skeptical and negative categories (for both sections) doubts as to what the new program could or would accomplish were expressed. The view that Science 10, an integrated science course for all students at the Grade 10 level, would be a repeat of junior high school science, would be a less challenging and valuable course and would be a set-back to science education emerged. The retaining of distinct discipline sciences at the Grade 10 level seemed to be the preference of several teachers whose comments were placed in this category. A few comments in the other categories of both sections also reflected this perspective; a longing for things to remain as they were. A comment demonstrating this sentiment was: "*My students will* at first be somewhat reluctant to be involved in this program instead of Chemistry 10, Physics 10 and Biology 10". As seen in several of the other comments some teachers were reluctant as well. The integrated versus discipline science issue was already being addressed in initial inservice activities and these first journal comments indicated it would require ongoing attention. In planning the future inservice activities the nature and value of the new integrated science program would have to be clearly demonstrated—the project inservice sessions would have to highlight the interconnections between the disciplines and the value of applying a broader science perspective rather than that of one particular discipline when problem solving in many areas of science, in technology and when considering science-related societal issues.

The comments in the other categories of both sections were varied; some positive, some negative and some non-committal. The many resources Alberta Education had mustered to support the program and the importance and advantages of the inservice program were noted by some teachers. The powerful modeling aspect of the first couple of years of implementation, the "make it or break it" aspect, was also pointed out. The large amount of time and energy required to make the changes along with the disorganization and teacher blunders that occur when relatively large curriculum changes are in progress were mentioned; teachers and students would be uncomfortable as they "find their way" during the transition period.

Figure 5.6:
Year One—Teachers' Rating of New Program Potential for Students
Percentage of Teacher Journal Comments by Category
My students will…



Sample Comments (73 comments categorized and considered)

Positive—81%

- learn critical and analytical thinking; become independent thinkers and problem solvers
- enjoy more hands-on activities
- be better equipped to make decisions based on what they have learned in the course; be more critical of what they read and hear; enjoy the course and be enthused about science and hopefully wish to continue on in science-related fields; have a better understanding of large scientific concepts; have a better understanding of global concerns and local concerns
- "turn on" to science, we hope; use science processes in fruitful lives; be apprehensive and uncomfortable—uncertain with less lecture, more activity; need support to adjust too!
- enjoy an integrative approach to science; like hands-on activities; find it difficult to change their mindset away from a discipline approach
- hopefully become more aware of their environment and become thinking, responsible individuals
- become more involved in the lesson instead of sitting like dead ducks
- be enthusiastic in September when they come into my classroom and I would like to nurture that enthusiasm with an interesting and challenging course
- should be better able to succeed in this course. It should provide what all our students should be getting from a science course application to their lives
- succeed; enjoy the program
- find Science 10 a challenge since it will require initiative of their own if they are to excel

- love this course!

Positive - discipline oriented—3%

- gain insight into what is involved in physics, chemistry and biology and understand their application to the world around us
- be better prepared for Physics in Grade 11.

Skeptical—1%

- learn inquiry skills but I am afraid they will be able to "waste" time; be difficult to control sometimes; likely be more scientifically aware.

Negative—1%

- perceive Science 10 as a "mickey mouse" course rather than science.

Other—14%

- have to cope with teacher blunders and disorganization until we get a grasp on what the new science (STS) is really trying to accomplish; leave high school with a more general look at science and realize that there are really no right or wrong answers instead, it is how they arrive at answer
- need to adjust to the Science 10 program: differences in course presentation, teaching strategies, and in evaluation of skills learned
- think they are still in junior high; be just as lost on their first day as I am/probably just as confused as any Grade 10 student
- be required to meet a high level of competency; have the advantage of a teacher who has been inserviced
- at first be somewhat reluctant to be involved in this program instead of Chemistry 10, Physics 10 and Biology 10.

A great majority of teachers (81%) were generally positive about the effect the new program would have on their students. They cited greater opportunities to learn higher order thinking/problem-solving skills in practical and relevant contexts, more excitement, interest and personal involvement in science, greater enjoyment and appreciation of science and even increased interest in career opportunities in the science area. A discipline orientation in 3% of the positive comments was noted and separated out and a comment in the "other" category indicated students would rather take the discipline sciences at the Grade 10 level than the new Science 10 integrated course. This was duly noted by the planning team as we realized a strong discipline focus remained with some of the teachers and would have to be addressed within the project; some teachers had quite a way to go before they would support the move to integrated science as a positive step. Only a few negative or skeptical comments were made while the comments placed in the "other" category were a mix of positive and negative; even within single comments where a teacher may express anxiety and doubts along with optimism for the possibilities for students (see the first comment in this category).

The teacher comments in these two sections overlapped to some degree as teachers expressed their beliefs regarding the potential of the new courses in both sections. The comments in both sections were overwhelmingly positive regarding the program directions with only a few being skeptical, negative or falling into the "other" category. It was pleasing to see that the majority of teachers viewed the new program directions as a positive change for students and teachers in spite of the workload involved in pioneering such a major curriculum change. The majority of positive responses in both sections zeroed in on the potential benefit to students. These included:

- facilitating science, technology and society connections (STS)
- developing strong skills through "hands-on" and "minds-on" experience (thinking skills/skill development focus)
- gaining knowledge of the full spectrum of science/making connections between the disciplines (integration)
- being better prepared for the future/more career possibilities/more students going into science
- more interesting/motivating—"put the zip back in science"

Year One Summary

Teacher expectations, anxiety and routine questions regarding field validation roles, responsibilities and resources as expressed in their **Year One** journals had been anticipated and planned for. The **Year One** inservice program was designed to reduce initial anxiety, build upon and extend teacher knowledge and skills so they could implement the new integrated Science 10 program with greater confidence. We worked diligently to develop trust between the Science Team and the teachers, to collaborate with the field validation teachers as colleagues within the project. Teacher questions and concerns we could answer were quickly and honestly addressed in daily plenary sessions. The inservice workshop sessions provided the practical focus teachers requested while at the same time providing foundation knowledge of the new program's philosophy, rationale and structure. Workshop leaders used Science 10 as the context in their sessions. The inservice activities were facilitated by teachers as far as possible and opportunities for teachers to interact in a positive, collegial and productive manner were purposely built into the inservice schedule.

The degree of optimism and enthusiasm expressed for the potential of the new program; the belief that the new programs would be more relevant, exciting and valuable for students while providing professional rejuvenation for teachers was a pleasant surprise. Teachers demonstrated in their comments an understanding and commitment to the new program directions beyond what we had expected. In spite of the huge workload involved in the field validation process, teachers indicated that generally they felt it would be worthwhile.

As a result of the complaints regarding Lister Hall, I decided to be extremely careful in the selection of teacher accommodations for the **Year Two** and **Year Three** inservice programs. However, I would have to work within the budget for the project, a budget that was becoming somewhat less each year.

The mix of reactions and responses in the teachers comments in these five fields—the various worries of how they would achieve the vision of the new science program coupled with their seeming support and optimism concerning that vision reminded me of my own ambivalent feelings as a parent, as a classroom teacher and as an inservice planner as I faced the challenge of setting and achieving new goals. So often the goal or vision and the achievement of such seem worlds apart. Self-doubt, lack of time and energy, fear of poor support or lack of resources lead to anxiety. Still, the goal remains desirable, even if difficult to achieve.

Year Two *Personal Journal* Analysis

University of Lethbridge
20-Level Science Inservice Sessions
June 21–25, 1992

This year of inservice activity was consolidated into one session in June with no August session or callback sessions possible due to budget restraint. Teachers were less anxious as they had now experienced one year of field validation and their confidence level had risen. They also had a higher degree of trust in Alberta Education—resources had been supplied on schedule and the field validation process had run relatively smoothly in **Year One**. A close collaboration between the field validation teachers and the Science Team had developed and a sense of a common mission. This had developed as a result of the many interactions between the teachers and the Science Team at the **Year One** inservice sessions, the single day callback session, the scheduled teleconferences, the school visits and the other informal communications throughout the year. The mood, as reflected in the **Year Two** teachers comments was considerably more positive than in **Year One**.

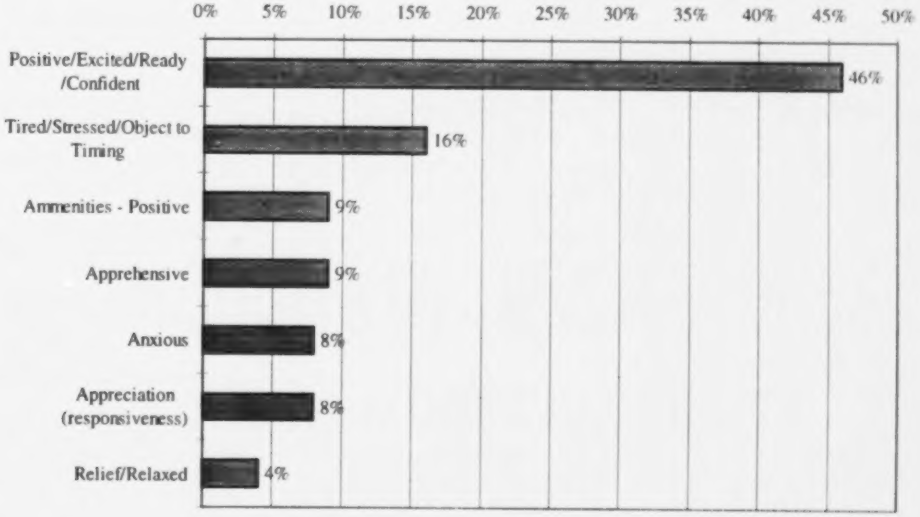
The physical setting and amenities were contributing factors to the generally positive attitude of teachers expressed as they began their **Year Two** inservice experience. The University of Lethbridge, a much newer facility than the University of Alberta, has a spectacular setting with a panoramic view of the Old Man River Valley. It offered a higher standard of accommodation and food services than in the previous year for approximately the same price. Teachers were accommodated in air conditioned suites, each with four private lockable bedroom rooms, a shared living room, kitchen and two bathrooms. The weather was sunny and pleasant throughout providing ideal circumstances for outdoor meals, special events and strolls between sessions.

In **Year One**, budget was available to fly teachers from the Northern Alberta areas of Fort McMurray and Grande Prairie to Edmonton sparing them from a long, five-hour drive. In the subsequent two years, less funding was available and the inservice sessions were held even farther south than Edmonton—in Lethbridge and Calgary. The northern Alberta teachers were asked to car pool to Edmonton and then board a chartered bus from Edmonton for the southward journey. In both **Year Two** and **Year Three**, in addition to the chartered bus out of Edmonton, Alberta Education paid the expenses for a northern school jurisdiction with many field validation teachers, to bring their own bus. One of the field validation teachers drove the school bus and picked up other teachers on route. In **Year Two**, the trip to Lethbridge was up to 10 hours long for some teachers. As seen in the comments, some found the trip was long and arduous while others found it a relaxing break. The chartered bus was available throughout the inservice period at the University of Lethbridge and was used to provide transportation for field trip activities and an optional general interest trip held in the evening; a trip to the World Heritage Site, *Head Smashed in Buffalo Jump*.

As the teachers faced **Year Two** of field validation they were being challenged to implement four new science courses at the Grade 11 level; Science 20 (integrated), Biology 20, Chemistry 20 and Physics 20. As a consequence, approximately 25 more teachers were involved in the project as more teachers were required to offer all these options than were required to offer Science 10 alone at the Grade 10 level. A good percentage of the teachers were called upon to teach more than one of the new courses and as a result the workload for them was greater, and in some cases much greater, than in **Year One**. One field validation teacher, the only science teacher in a small rural school, was involved in teaching all four of these new courses during in **Year Two** of the project.

In **Year Two**, teachers of Science 20 would again be working with draft student textbooks (*Visions 20*) and teachers guides while those teaching the discipline sciences would be provided with bound, final copy textbooks. The student textbooks being field validated for Biology, Chemistry and Physics all covered both the 20 and 30 levels; the Grade 11 and Grade 12 years. Two books were being validated for each of the discipline sciences and each school was to receive both textbooks—half their allotment would be one book and half the other. The initial reaction to this arrangement was not favourable as teachers felt working with two different textbooks was more difficult than working with one. Alberta Education provided textbooks in this manner, the two different textbooks for each discipline science course, to assure a fairer test. Students and teachers would have an opportunity to work closely with both resources and to compare; a circumstance that would be impossible if they were working with only one of the available texts. In the end, teachers and students adapted well to this arrangement. In **Year Three**, schools chose which student text they would use for each level of each discipline. A common choice for the next school year was for a school to order both textbooks, one for Grade 11 and one for Grade 12, although many schools also chose to use one or the other for both years. Teachers in schools that eventually went totally toward one book or the other expressed the value of having the additional copies of the alternative text for student and teacher reference purposes; for supplementary problems, alternative coverage of content and enrichment.

Figure 5.7:
Year Two - Teachers' Affective State
Percentage of Teacher Journal Comments by Category
I am feeling…



Sample Comments (77 comments were categorized and considered)

Positive/Excited/Ready/Confident—46%

- confident that the program can succeed having done the Science 10 program/positive
- it is good to get away from the regular demands and concentrate on the implementation procedure
- a lot more comfortable than last year. I'm prepared mentally and at school for this week
- happy to be involved again with this group of people/happy to be here and to get reacquainted with colleagues
- excited about some of the workshops being offered - they should be interesting.

Tired/Stressed/Object to Timing—16%

- a little stressed/tired because of the time of year/Interested but tired. I'd be enthusiastic if I wasn't so tired
- I am feeling tired and edgy. It was a long trip. The Science 10 course was long and involved. The people on my bus were not very cooperative
- slightly disgruntled as I am losing four days of school time (including the last teaching day). It is stressful when one is teaching more than one course, including the pilot course to spend the prep time at the beginning of the year and the marking time at the end in sessions a days journey from home
- final exams have not yet been given in our school jurisdiction. Since our entire science department is here, it is difficult for students to receive help if they require or request it.

Amenities—Positive—9%

- good rooms, good food. Have it here next year. Don't risk going to U of C
- really pleased with accommodations and food
- very comfortable in the accommodation; rooms are just great. So is the food. Thank you.

Apprehensive—9%

- I am feeling uncertain as to how the new Chemistry 20 course will better prepare students for future goals.
- I am feeling excited and nervous about next year (mixed comment—also counted in 1st category).
- I am feeling a bit nervous. Never been at such a large session. Anxious. Want to get as much information as possible.

Anxious—8%

- I am feeling anxious to take a closer look at the new Physics 20 program
- apprehensive about teacher only assigning 20% for process skills.

Appreciation —8%

- I am feeling Alberta Education has bent over backwards to make the implementation of the new science courses as easy as possible
- I have a tremendous admiration for all the work being put into introducing the new curriculum by the "Edmonton" team.

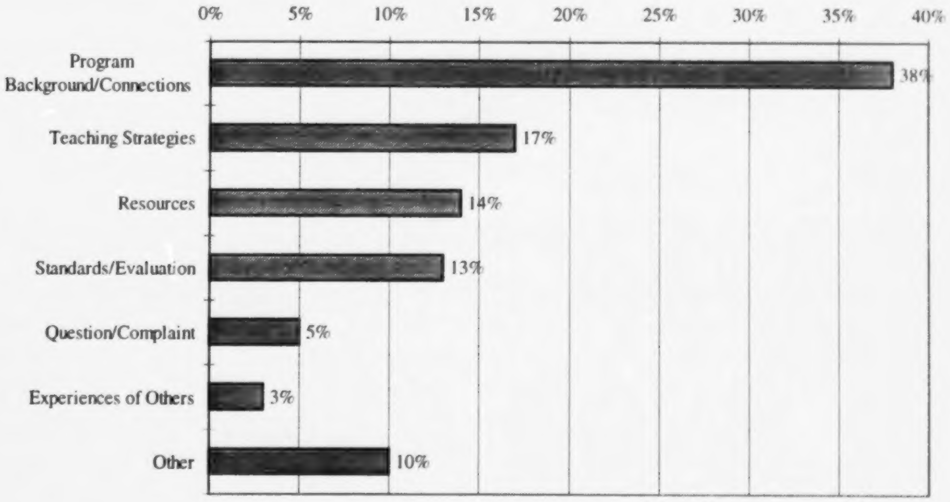
Relief/Relaxed —4%

- relaxed/relieved that the year has finished.

The **Year Two** "I am feeling…" section reflected a great shift in confidence level of the field validation teachers. In **Year One**, 33% had expressed anxiety with 29% expressing a mixture of anxiety and anticipation. Now 46% were expressing confidence and anticipation of the challenge. Anxiety and apprehension together showed up in only 17% of the comments. Expression of appreciation of the improvement in accommodation and amenities as well as of the Alberta Education efforts to support teachers emerged. The fact that teachers were tired and did not appreciate leaving their schools during scheduled examination time was very evident with a full 16% commenting on this aspect.

The teachers had gotten to know one another in the **Year One** inservice activities; they had met teachers from several other schools as a result of the mixed groups that were drawn up for the various workshops. Many teachers I spoke with commented that they had also really gotten to know their own school science teaching colleagues much better as a result of time spent together at the inservice. The inservice "time away" brought school science teaching staffs together with common purpose as well as providing opportunities for teachers from different schools to get together. The additional one day callback session; one for Northern Alberta teachers and one those in Southern Alberta, served to strengthen the informal networks as did the many teleconferences held in **Year One**. Teacher comments in **Year Two** once again reflected anticipation and valuing of the many networking opportunities the inservice provided.

Figure 5.8:
Year Two—Teachers' Specific Questions/Concerns
Percentage of Teacher Journal Comments by Category
I want to know…



Sample Comments (97 comments were categorized and considered)

Program Background/Connections—38%
- about the program and what the expectations should be/more about the upcoming programs in terms of what to expect curriculum wise
- as much as possible within the two constraints of time and endurance/everything about the new curriculum for chemistry and physics.
- the topics/concepts, detail and level of material to be covered.
- more about the concepts outside my subject area (biology and geology specifically).
- how to make connections between physics, biology and chemistry/how the 20-level

discipline courses e.g. Biology 20 will connect with Science 10 and employ the strategies used in Science 10.

Teaching Strategies—17%

- how to motivate students to be responsible for their own learning. (I found my students think of activities as play/fool around time.)
- basic planning ideas/some possible methodology for teaching the courses/information, strategies and helpful hints
- about activities for the 20-level courses/activities that are considered key to the Science 20 program/tour/field trip ideas/what strategies worked in Science 10
- how can I teach Science 20 in a unified way rather than one theme or topic at a time
- more ways of applying concepts to real life situations that are relevant and interesting.

Resources —14%

- about the new reference materials/where to find the resources to present the courses
- if we will see a hard cover text for Biology by August/will the modules be here on time
- what new resources are available and what old resources/equipment I can still use.

Standards/Evaluation —13%

- just to get a feel for the expectations at each level
- much, much more about evaluation. All new texts and resources have the same standard evaluation procedures and yet this approach is to be so much different
- how assessment should take place/what areas can there be student involvement
- more about evaluating developing process skills
- more about 40–40–20 split: the 20% for skills evaluation troubles me.

Question/Complaint—5%

- what the new program will do for students/why students will like this course and method more.
- why we need four days and why those of us with difficult schedules are penalized for mileage claims because we aren't able to form a car pool of three.
- whether Alberta Education realizes that new curriculum is only about 15% of what I do! And if they (AE folks) realize the tremendous demands that are on a teacher's time?

Experiences of Others—3%

- about the experiences of the field testing groups/how other teachers have perceived the Science 10 course to have gone/student and teacher feedback to Alberta Education.

Other—10%

- I want to know more. Always room to learn/as much as possible to help my students and colleagues.
- if the new courses will be as exciting to teach as we expect them to be
- the distribution of students taking Science, Chemistry, Biology and Physics 20 throughout the province.
- why my colleagues are so afraid of this program. It sounds like a great new initiative
- the times for things—from the schedules provided, some times were vague.

In the **Year Two** teachers continued to show interest in the most of the same areas they had in **Year One**: program background, teacher background, teaching strategies, resources, technology and student evaluation. Very few comments regarding the roles and responsibilities of the field validation teachers or of Alberta Education were made as these had been well defined in

Year One inservice activities and through the various project experiences. The roles and responsibilities aspect was to be briefly summarized once again in the **Year Two** plenary sessions as several new teachers were joining the project for the first time in this year.

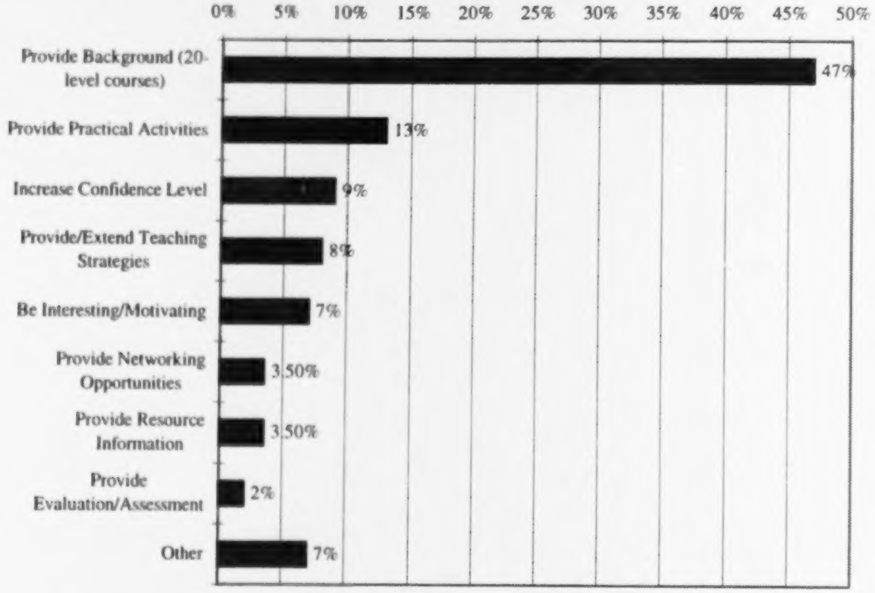
Providing discipline specialist teachers with background in all discipline areas to increase their comfort level with the integrated science program remained a high priority. Four compulsory morning sessions of sample activities for the 20-level science courses were provided as this type of session had been so well received in **Year One**. Three of the four hands-on activity sample sessions were designed to provide activities that would be applicable to both a 20-level discipline science and Science 20 while the fourth session concentrated on geology and paleontology activities for Science 20; activities which only a few teachers had background in. Teachers worked through the activities in small groups that reflected a mix of discipline expertise so they could coach one another as well as receive assistance from the workshop facilitators; an Alberta Education consultant and an experienced classroom teacher.

A variety of workshops was offered in each of the three afternoons to allow teachers to chose what sessions they would find most useful. In **Year One**, teachers had experienced a common foundation of inservice sessions. In the **Year Two** and **Year Three** a common core of compulsory morning sample unit activities was coupled with afternoon workshops that allowed for teacher choice was provided. This variety of workshops offered each afternoon was designed to better meet the diversity of needs expressed. An example of an afternoon session of choice was one on the composition of the Earth and Plate Tectonics to provide background for the teaching of Unit 1 of Science 20. This session was offered by a geologist team. Teaching strategies were a major focus with a wide choice of sessions being provided on appropriate STS contexts for the new 20-level courses, on cooperative learning, on field studies, on the thematic approach, on using technology and on minimizing chemical wastes. Inservice event schedules and workshop descriptions are presented in Appendix F.

A new area of teacher interest that emerged in **Year Two** was the connections from one course to another; the linkages between Science 10 to the 20-level sciences and on to the 30-level sciences. These linkages had been carefully mapped out by the Science Team and were provided in chart format. They were addressed in the workshops dealing specifically with appropriate hands-on activities for the four new 20-level courses.

Interest in student evaluation/standards and assessment increased from 3% to 13% with many questions about the skills evaluation component being asked. The evaluation and assessment theme continued in inservice sessions offered in all three years of the project. In **Year Two** all workshop facilitators were requested to provide suggested evaluation criteria for the particular strategies being discussed, demonstrated and practiced, as appropriate; i.e., model hands-on activities, cooperative learning, field studies. A session on planning for student assessment was one choice offered in the afternoon segment of the inservice.

Figure 5.9:
Year Two - Teachers' Inservice Session Expectations
Percentage of Teacher Journal Comments by Category
I expect these workshops to...



Sample Comments (87 comments were categorized and considered)

Provide Background (20-level courses)—47%

- to help me get a feel for the new approach to relate specific concepts to the real world
- to inform about Science 20 and all that is in between/to provide a good foundation for intelligent planning of Science 20 and re-planning of Science 10
- to be extremely beneficial in background knowledge to give me a start in areas I know little or nothing or less than nothing about/give us a head start in preparation of the pilots
- give insight and useful information and prepare me for Round #2 of field testing
- to provide information, valuable experiences and ideas for me to take back
- guidance and ideas for implementing the new courses/to help answer questions and suggest some new ideas/some ideas for good units, projects, etc., for the courses.

Be Practical—13%

- to provide a good level of Science 20 activities
- to provide hands-on contact with how to do labs/avoid potential pitfalls and help choose which activities are best in our situation
- to be practical. I like the proposed field trips/applicable to my situation/to help me develop ideas for activities, field trips.

Increase Confidence Level—9%

- give me confidence to tackle the new curriculum/help teachers feel more confident about their abilities to handle these new programs
- to give me new ideas and the confidence to implement them as I have seen what a relevant curriculum and hands-on learning has done with my Science 14 students and have been dissatisfied with the lecture approach of STSC Chemistry 10 and 20
- give me the same level of comfort with the 20 courses as last year's inservice did for the Science 10. They decreased anxiety.

Provide/Extend Teaching Strategies—8%

- to give ideas to vary presentations in the 20-levels courses especially Science 20
  to provide innovative ideas and activities to make the course interesting and challenging/ information about the various teaching techniques to be used
- give me food for thought as to which teaching style is best for me!
- further opportunities to learn about various teaching strategies and extend what I have learned about teaching strategies already; e.g., cooperative learning.

Be Interesting/Motivating—7%

- to be interesting and informative/motivate me, inspire me, make me positive to the new changes
- to excite or at least stir up my interest (its hard to excite a teacher in late June) for the next September pilots.

Provide Networking Opportunities —3.5%

- an opportunity to talk with other teachers/a chance to make contact with other piloting teachers/to find out teacher and student feedback to Alberta Education/provide opportunities to meet other teachers and share ideas with them.

Provide Resource Information—3.5%

- to provide me with some valuable resources in materials and ideas for the coming term/to give me information on materials available.

Provide Evaluation/Assessment Strategies—2%

- provide me with a framework for evaluating student work/provide information on how to evaluate course content/more about evaluation methods to be used in the 20-level science courses.

Other —7%

- to be a lot more to the point than previous sessions
- to enhance what I've already learned and to strengthen my weaknesses.

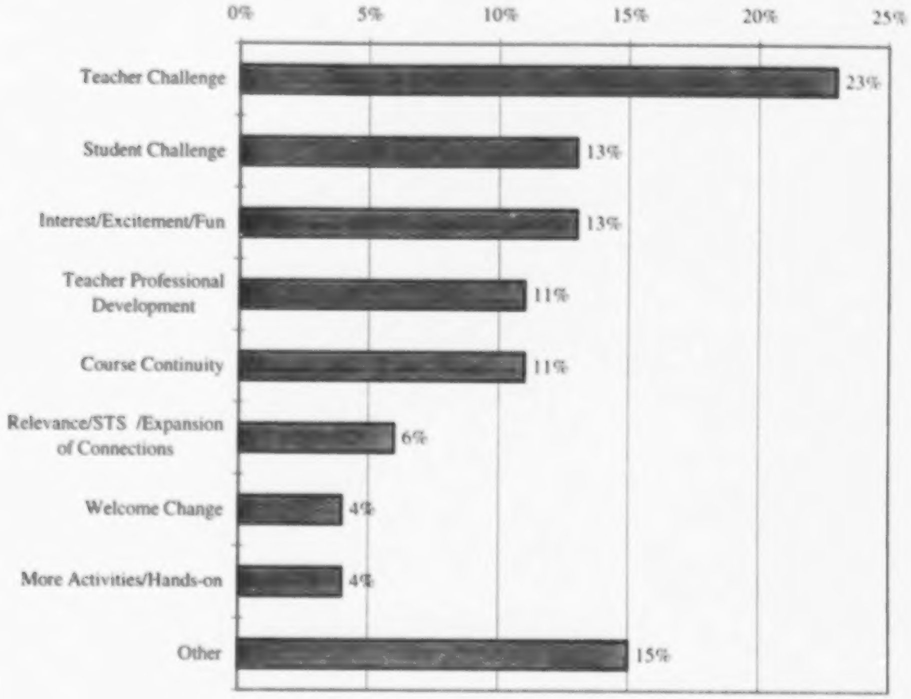
The majority of comments in this section indicated the expectation that the inservice workshops would provide specific background for the teaching of the new 20-level science courses (the expectation that suitable background be provided jumped from 16% in **Year One** to 47% in **Year Two**). As mentioned in the previous sections this is what the planning of the **Year Two** inservice sessions aimed to accomplish. Practicality was an important factor as it was in **Year One**. To address this aspect inservice workshop, leadership was provided as far as possible by practicing classroom teachers who "practiced what they preached". Once again, four hands-on model activity sessions with sample evaluation criteria were planned to address that continuing appeal for practicality. References to Philosophy and Rationale had dropped from 15% in

Year One to no mention in **Year Two** indicating that teachers now felt they had a good understanding of the "why and what" of the new program directions.

The mention of resource information had also dropped substantially in **Year Two**—from 10% to 3.5%. This was likely a result of specific resource information being supplied before arrival at the inservice and resources being available and distributed with the inservice registration packages. The majority of teachers had developed confidence in the resource provision process through their experience in **Year One** with student and teacher resources promised by Alberta Education being provided on time and proving generally useful. Priority continued to be given in the project planning to assuring the continued timely availability of these resources in **Year Two** and **Year Three**. With the *Visions* series custom development project an initial draft was provided to teachers at the inservice in June and followed up in mid-August with a final field validation draft as text development continued through July and early August. Timelines were very tight for the development of this series and every available moment during the July–August period was used for refining the initial draft and printing and distributing the field validation draft. The original plans had called for the field validation drafts of the student texts and teachers guides to be available for the June inservice activities each year, but these deadlines were never met. The teachers were reasonably content with the initial student text drafts and very few complaints regarding the later forwarding of the field validation draft and the draft teachers guides were received.

In **Year Two**, 9% of teachers specifically mentioned that they expected an increase in confidence level and 7% expected the sessions to be interesting and motivating; together these were about equal to the 15% expectation for professional development in **Year One**. Both increase in confidence and being interested and motivated are related to professional development and that was an aspect teachers continued to expect in the sessions. Teacher networking opportunities and evaluation and assessment were also mentioned by a small percentage of the teachers. High teacher interest, motivation and an increase in confidence were major goals of inservice planning throughout the project.

Figure 5.10:
Year Two—Teachers' Expectations of New Course(s)
Percentage of Teacher Journal Comments by Category
The new 20-level sciences will…



Sample Comments (53 comments were categorized and considered)

Teacher Challenge—23%

- be a challenge to teachers. Not only will they have to deal with a new program of studies but a new style of teaching as well. They are going to need a lot of help and support
- interesting and challenging—more fun for me and thus more fun for my students
- will require a lot of preparation to prevent them from being the "old" science with new titles/take more of our time to organize and evaluate
- be a challenge to teach, but also rewarding/be challenging and take a high degree of organization (teachers and students)/a challenge to start up and keep being creative.

Student Challenge —13%

- test students' ability to organize and solve the problem presented
- will involve a more experimental approach for students. They will hopefully "bug into" the learning process to a greater degree than before
- give students a more concentrated look at all three disciplines
- require students and teachers to work more intensely to finish the courses. (two categories—teacher and student challenge).

Interest/Excitement/Fun—13%
- be exciting to teach/will be just as exciting as the Science 10 course was
- will be great for students/interesting and fun.

Teacher Professional Development—11%
- an opportunity to rejuvenate, introduce and test new ideas and methods/allow me to try some new stuff
- improve science instruction in high school. Lead to more hands-on experimentation in science classes. Improved and more comprehensive evaluations.

Course Continuity—11%
- hopefully connect with previous courses/tie in all the sciences
- build on the foundation laid in 7-10. Provide appropriate opportunities in science for all students/build on the foundation laid by Science 10
- continue with the thematic approach.

Relevance/STS/Expansion of Connections—6%
- hopefully expand on everyone's science interest/curiosity/a wider science experience for students
- provide average citizens with the knowledge they need to make decisions about science and technology.

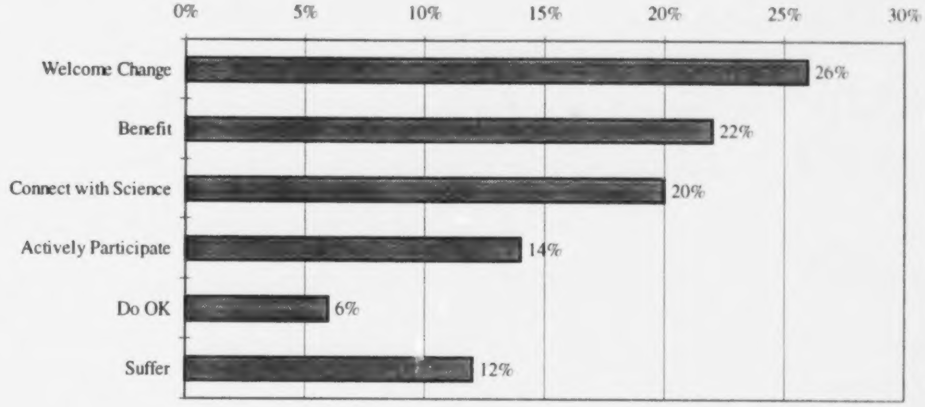
Welcome Change—4%
- a welcomed change with respect to last year's Biology 20.

More Activities/Hands-on—4%
- will be different - hopefully more activity oriented than the old Biology 20–30.

Other—15%
- meet the needs of today's science students/hopefully encourage more students to stay in the field of science/lead to a better way for students to approach problem solving.

In **Year One**, before teachers had any direct experience with teaching the new program, a high degree of optimism and support for the new program directions was expressed (77%). In **Year Two**, after one year of field validation experience, teachers were more specific about particular features and aspects of the new programs. The tone of the comments, again mainly positive, reflected the real challenge the 20-level science courses posed to teachers and students; the new courses although interesting and exciting would demand a lot of teacher and student commitment, organization and plain hard work (36%). A full 13% of teachers provided comments indicating that the new courses would be interesting, exciting and fun for students and/or teachers with 4% making statements indicating the new courses would be a welcomed change. The new 20-level courses were seen as providing course continuity—transition from junior high science and Science 10 on to the graduation level 30-level sciences. The courses were also seen to provide strong links of science to everyday life, relevance through science, technology and society connections and to provide more activities for students, particularly hands-on activities. Their implementation was viewed as a strong professional opportunity and a welcome change. The comments in the "other" section continued to reflect generally positive expectations for the new courses. The comments were indicative to the Science Team that teachers who were now facing implementation of four new courses rather than one within their schools, often teaching more than one new course, would require continuing and increasing amounts of formal and informal support during **Year Two**. In **Year Two**, the Science Team was responsible for curriculum and textbook development/field validation and development of evaluation criteria and samples for four courses rather than one as in the previous year. Given the demands on Science Team members' time and talent it would be a definite challenge to maintain and increase teacher support as the workload increased substantially.

Figure 5.11:
Year Two—Teachers' Rating of New Program Potential for Students
Percentage of Teacher Journal Comments by Category
My students will…



Sample Comments (66 comments were categorized and considered)

Welcome Change—26% • enjoy the courses and become curious about science. Rediscover love of science and learn more than facts/enjoy the challenge of the new courses • learn, choose/have input into their courses, have fun • become more excited about science/like the paleontology • find the information and facts that I learned here interesting as I hope to find them • probably continue to enjoy the continuation of the new courses. They enjoyed the activity approach.
Benefit—22% • benefit because I am better prepared/benefit from my attendance at these workshops/ benefit from my enthusiasm • our students will be exposed to a variety of strategies which ultimately will develop better thinking and problem-solving skills • have a more general knowledge of science/have an opportunity to learn about all disciplines • benefit from the variety of learning experiences which will be possible in the new Biology 20 course/have more time to obtain a better understanding of ecological and physiological concepts • benefit from the blend of practical and mathematical physics • be encouraged to continue on in post-secondary courses/see possible job opportunities.

Connect with Science—20%

- appreciate the complexities of science/hopefully feel more at ease with the scientific method!
- find the courses relevant and interesting/relate science to their everyday situations/should see the implication of information in their daily lives
- be able to make connections with the world around them in order to become more responsible world citizens. Science for science's sake is not important.

Actively Participate—14%

- do more labs and activities/enjoy more activity/enjoy the hands-on aspect of the new courses/enjoy being more actively involved/learn "hands-on"
- will be more involved with Chemistry because of the STS emphasis.

Do OK—6%

- do okay if not better/make it through these as I do/be 50/50
- won't be overwhelmed like in Science 10.

Suffer —12%

- be apprehensive about the new program and what it will mean to their future
- have trouble choosing which courses to take, even with rather careful prompting from myself and our counsellors
- see the amount of Chemistry in Biology 20 and freak out/find the new Physics 20 harder than the old Physics 10–20 sequence. The proposed courses have a large leap between Science 10 and Physics 20
- complain that courses are boring
- the weaker student may suffer more by not accepting responsibility for his own learning
- be frustrated over the use of 2 texts in the pilot
- continuity to the 30-level courses will not be there.

In **Year Two**, as in **Year One**, teachers comments continued to express generally positive expectations for their students involved with the new science program. The first five categories in this section were all positive: *welcome change, benefit, connect with science, actively participate* and *do OK*. Together they totaled 78%, very close to the 81% positive comments of **Year One**. The teachers, based upon their experiences with their students in **Year One** of the field validation, continued to expect positive involvement, benefits and student performance.

On the other hand, 12% of teachers expressed comments indicating they believed their students may be/would be disadvantaged in some way by being involved in the **Year Two** validation. There were strong messages in this section regarding the amount of content and rigour in the new programs. These were seriously considered along with similar references in other journal categories and provided supplemental information to the formal feedback forms on the program that teachers completed and submitted to the Science Team. Close examination of all course content and an eventual reduction of course content was the result. Some comments, such as "boring" and "lack of continuity" were puzzling as the majority of teachers thought the new courses were better connected and more interesting and engaging than the previous ones. Such maverick comments alerted us to the presence of alternative and in fact opposite perspectives on the new courses within the field validation teacher cohort but resulted in no particular action.

Year Two Summary

A significant improvement in the accommodation and amenities available for the **Year Two** inservice resulted in positive comment and a generally more positive beginning to the **Year Two** activities. Teachers had one year of field validation experience and were more confident and familiar with the processes involved in the project. Nevertheless, teacher comment reflected varying degrees of fatigue after an extremely demanding Science 10 field validation year. They now faced the 20-level sciences implementation and they knew that was going to be even more demanding.

One particular comment in the *I want to know...* "Other" category captured my attention.

> *I want to know* whether Alberta Education realizes that new curriculum is only about 15% of what I do! and if they (AE folks) realize the tremendous demands that are on a teacher's time?

As previously explained, the new science curriculum field validation and implementation project was extremely ambitious with tight timelines. The fact that teachers were often teaching both the new science programs and other subjects while still completing their other professional commitments always had to be considered. The expectations of the field validation teachers and the Science Team; to validate the program of studies and the draft resources and to develop appropriate assessment instruments was a very tall order—not to mention the fact that many field validation teachers were providing additional professional leadership on the new programs within their school jurisdictions and for the Alberta Education provincial information sessions. Several field validation teachers also authoured various sections of the teacher resource manuals and professional development workshops Alberta Education developed to support provincial implementation. It was no surprise that several teachers made reference in their comments to the fatigue and overload experienced as they were involved in the field validation process.

With several teachers, the timing of these June inservices continued to be a bone of contention. These teachers felt they should not be asked to leave their schools when their students were writing their final examinations, particularly the diploma examinations in the 30-level sciences. The reasons for this end of June scheduling were both pedagogical and financial.

Year Three *Personal Journal* Analysis (final year)

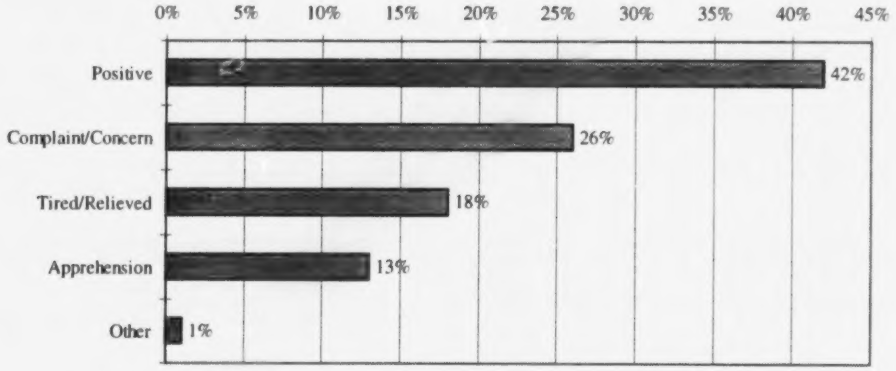
30-Level Sciences Inservice Sessions
University of Calgary
June 20–24, 1993

For **Year Three**, the final year of the field validation, the 30-level sciences inservice was once again held in late June during the week of provincial diploma examinations. The University of Calgary on-campus residences were similar to those in Lethbridge with four to eight teachers being accommodated in each suite. A suite that had 2 to 4 rooms each accommodating two people and opening onto a common living room area, bathroom(s) and a kitchen. These residences had originally been built for the athletes at the 198? Olympic games in Calgary and were relatively new, spacious and well maintained. The food services also proved to be excellent. Meal cards were issued and were placed in the back of the plastic pocket holding each participants name tag (name tag pocket was held on a string around the neck and the string held pockets were reused each year). Participants would simply show their name tag, chose whatever they would like to eat and it would be charged to the Alberta Education account. This system worked very well and allowed complete freedom of food choice for the teachers.

A particularly strong partnership with the Faculty of Science at the University of Calgary resulted in close collaboration of the Science Team and teacher leaders with professors from the Departments of Biology, Chemistry, Physics and Geology. This collaboration resulted in many excellent sessions being provided; sessions ranging from hands-on unit activity sessions offered in University of Calgary laboratory facilities, sessions providing science background for teachers to a half day Geology field trip to the Rocky Mountains. The provision of background on strong STS contexts and teaching strategies that would support the various 30-level science courses was also a focus with many choices offered in the afternoon session time slots.

Evaluation and assessment continued to be an important aspect within the inservice a plenary session devoted to the topic, evaluation criteria provided for all hands-on activities and some sessions of choice on aspects, such as peer evaluation being available.

Figure 5.12:
Year Three—Teachers' Affective State
Percentage of Teacher Journal Comments by Category
I am feeling…



Sample Comments (99 comments were categorized and considered)

Positive—42%

- positive—it seems to me that some teachers are having trouble accepting the new focus and trends in the curriculum. I have a hard time seeing where their problem is coming from. Is it that they prefer the old lecture/lab/assignment teaching format, or the traditional "memorizable" steps to problems? I'm not sure what I can do to keep kids positive, and to keep the other teachers in the school believing in the new program
- hopeful and optimistic/looking forward to four interesting days/looking forward to the sessions/I will make the best of what is presented
- good about having a chance to "touch base" with other teachers and find out about how their year went with the pilot implementation of the 20-level courses
- privileged to be able to be a participant at the inservices for the past three years/proud to

have been part of this project—grateful to the organizers from Alberta Education, especially Bev!

- ready—I have attended the Science 10 and 20-level sessions previously—thank you—very informative—please if it is possible have one every year (or 2 years)—it would be good for teachers that are not piloting the courses—great job!
- really excited about the inservice—had a great time in Lethbridge and looking forward to learning more about the 30-level courses—also hoping to share ideas with teachers from the 20-level pilot courses—very glad to be included in these inservices as it certainly made a difference in getting ready for the new courses
- relaxed and enthusiastic about anticipated sessions and meeting other teachers
- much more relaxed this year than last. I recognize faces, understand the general philosophy of the science courses, and I am prepared for the next four days
- great that I don't have to supervise diploma examinations for four days
- appreciate the fact that we have choices for the PM sessions.

Complaint/Concern—26%

- counsellors and students need to know the positive as well as the negative aspects of the course. Students need to know the actual requirements to continue in the program (Science 20–30)
- that Science 20–30 is being viewed as a second or perhaps last choice to many schools/school jurisdictions
- nervous about the placement of Science 30 in regards to the other 30 sciences and which students seem to be gravitating into the Science 20–30 stream
- students feel limited by Science 30 and therefore they do not enroll in it—I would like to know what 40–40–20 means
- that the Science 20–30 program is driven by the universities not the needs of students/ frustrated with the amount of material to be covered
- that my expectation in Biology may be too high. Maybe we need some more specifics on learner expectations. I would hate to see Biology 20 become the "catch all' for underachievers
- skeptical about the diploma examination stuff. Evaluation for all the pilot courses from day 1 back at the U of A has been very shaky with no real direction.

Tired/Relieved—18%

- relieved that we are being given this inservicing
- tired and relieved we have made it to this stage
- tired/a heck of a trip—the bus was welcomed! (northern Alberta teachers car pooled to Edmonton where they boarded a chartered bus for the trip from Edmonton to Calgary)
- tired—it's the end of the year and 9 hours on the road sucks. Glad that we are at the "end" of the road as we implement the 30 programs
- tired after a long semester/feeling usual June burn-out/exhausted.

Apprehension—13%

- apprehensive about the change in my teaching requirements—this will be my first experience teaching Biology 30
- apprehensive about how some of the material in the new Physics 30 will be evaluated
- somewhat lost—I find it difficult to get into the mindset of what is being requested of 30-level courses
- feeling in need of direction on the depth of the new Science 30

- concerned about my students' performance at the 30-level
- somewhat apprehensive about the new lab skills marking component but I suppose that it will work out
- cynical and apprehensive.

Other—1%

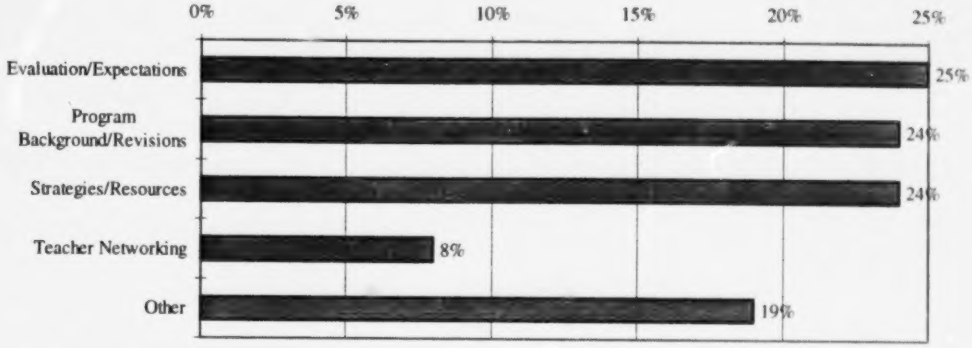
- a little behind the pack as the issues discussed so far are above what I have time to worry about
- disoriented—I have never been on this campus before.

In **Year Three**, approximately the same percentage of teachers made positive statements indicating they were feeling generally good about the field validation project and the inservice activities they were about to experience (45% **Year Two**/42% **Year Three**). The beginning of the final year of field validation found many teachers (18%) tired and relieved that they could see the "end of the tunnel". Although the comments in this category expressed fatigue they were not particularly negative. Some positive statements regarding appreciation for the inservice and for the chartered bus service were also found with expressions of relief and fatigue.

Approximately one quarter of the teachers registered a specific concern or complaint in this final year. Concern regarding the nature of the students enrolling in Science 30 and the possibility of low enrollment numbers in this course were expressed. Efforts to secure university acceptance of Science 30 as a strong alternative university entrance science course had not been as successful as Alberta Education had hoped, although negotiations were continuing. This continues to be an important issue and is still being addressed by Alberta Education. Some teachers were expressing frustration with the amount of content in the new programs with Science 20-30 being viewed as "overstuffed" . This view was explained by some teachers as a result of the universities and not the needs of students driving the Science 20–30 program. One teacher was concerned by the possibility that Biology would become a repository for underachievers. This comment likely arose as Science 20–30, being an integrated program with physics and chemistry components was being viewed by some students as more difficult than Biology 20–30. The importance of realistic and accurate student regarding Science 20–30 was mentioned—the pros and the cons had to be clearly laid out if students are to make informed decisions regarding the appropriate high school science route for them. Skepticism regarding students assessment and evaluation, particularly with the diploma examinations was mentioned by one teacher with an appeal to clarify 40–40–20 made by another.

Apprehension about teaching the new 30-level science courses for the first time was expressed with this being related to the need to understand the depth of coverage and the evaluation and assessment specifics, including information on the skills assessment component and the diploma examinations.

Figure 5.13:
Year Three—Teachers' Specific Questions/Concerns
Percentage of Teacher Journal Comments by Category
I want to know…



Sample Comments (135 comments were categorized and considered)

Evaluation/Expectations—25%

- what depth to teach the 20 and 30-level courses/expectations for the labs in the 30-level courses
- what the expectation will be for the 30-level courses/exactly what is expected of the students as to outcomes and achievements at the 30 level
- what is going to happen with the 30-level final exams/more about the 30-level diploma exams/how to prepare students for the new diploma examinations/evaluation format to be used for the 30-level courses
- more detailed expectations re: performance objectives for students/more about process skill evaluation and some practical ideas about how to do it
- why sample evaluation questions provided by the Department are so difficult at the 20 level
- how other teachers evaluate assignments other than with pen and paper (checklists, peer evaluation, etc.)/if peer evaluation will be appropriate to use in my classes.

Program Background/Revisions—24%

- what to expect with the 30-level courses/how the new 30-level courses will differ from the old courses
- more about the 30-level programs since I have not spent much time on any one discipline
- more about chemistry, physics, geology, geography to apply to Science 20–30/more about geology and its application to my area
- more about Biology 30 (and/or Chemistry 30, Physics 30, Science 30)
- if Science 20 and 30 have been modified to become more applicable to students
- what modifications to Science 20 will be made for the benefit of the students (not Uof A) and to Science 30.

Strategies/Resources—24%

- activities I can use/practical ideas about how to do it
- innovative methods/new ideas for old topics/on how to handle the new courses
- more about STS incorporation/more about effective use of contexts for science exploration
- lab activities that work/labs for physics/how to handle the safety aspects for the new lab activities.

Teacher Networking—8%

- how other teachers evaluate assignments/are evaluating
- if other schools are setting mathematics prerequisites for the 20 and 30 level science courses.

Other—19%

- if the teachers implementing Science 10 this school year and facing the 20-levels next year are feeling as stressed and angry as we did in session one in Edmonton (before we began)? Was that a one-time phenomenon or is the anger necessary before you can let go of the past and accept the future?
- everything/so much/as much as I can learn while I stay at the U of C
- time frames for units in the 30-level courses
- how we can prevent Science 20–30 from evolving into Science 23–33 (lower level stream)
- know more about the type of students we should advise to take Science 20–30 as opposed to Biology 30
- if there will be a callback session for us in the 1993–94 school year.

In this third and final year, interest in-depth of coverage and student evaluation and performance expectations jumped to a full 25% from 3% in **Year One** and 13% in **Year Two**. Diploma examinations were a major focus with information on the examination format, development and field validation process and on how student preparation being requested. Appeals for a practical evaluation framework for the 30-level courses and questions regarding the evaluation of the skills/laboratory component were registered. As explained previously the diploma examination year is a critical year to teachers and students. A strong interest in evaluation and assessment with particular focus, on the diploma examinations had been anticipated and planned for in the **Year Three** inservice activities. One teacher expressed the view that the sample evaluation questions supplied for the 20-level sciences were too difficult. This issue was discussed at length in a plenary session and the "draft" nature of these sample questions once again carefully explained - the samples had not been field validated and were meant to be a starting point only.

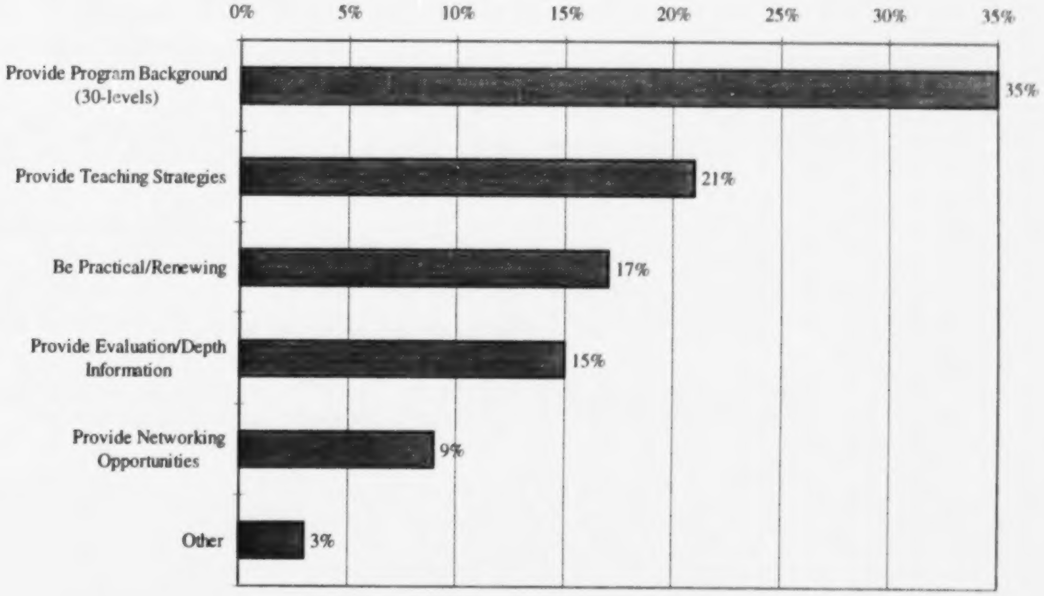
Approximately one quarter of the teachers wanted specific course information for the 30-level sciences and more science background in the various disciplines to prepare them to teach the new 30-level courses, particularly Science 30. The revisions made to the 20-level courses and the 30-level courses as a result of the field validation process were also of great interest. One comment in this category indicated that changes to the Science 20 course should be to the benefit of students and not to the University of Alberta, again highlighting the dilemma of balancing the content in this new program to meet the needs of students and yet gain university acceptance for the program.

Teaching strategies and resources continued to be a high interest area with approximately one quarter of the teachers indicating more exposure to new and practical methods for areas, such as the incorporation of STS and laboratory activities would be appreciated. As mentioned previously, the morning sample unit activity sessions and a choice of sessions in the afternoons were planned to address this need.

Teacher networking opportunities were indicated by 8% of the teachers with specific mention of networking for the purpose of comparing teachers evaluation and assessment methods, and how different schools are setting the mathematics prerequisites for the 20- and 30-level science courses.

The other category was large in **Year Three** with almost 20% of the teachers comments falling here; comments that were diverse yet important. The first comment regarding wondering how the teachers implementing Science 10 would be feeling is dealt with in the **Year Three** summary section p. ---. The issue of the Science 20–30 course evolving into a lower level course (Science 23–33) and the need for clarification of the type of student that should be advised to take Science 20–30 as opposed to Biology 20–30 were raised. These concerns are similar to those raised in the Evaluations/Expectations section and are ongoing issues discussed in the Final Words section at the end of this chapter. The remaining questions raised in the other category were addressed during the inservice plenary sessions and workshop sessions.

Figure 5.14:
Year Three—Teachers' Inservice Session Expectations
Percentage of Teacher Journal Comments by Category
I expect these workshops to…



Sample Comments (98 comments were categorized and considered)

Provide Program Background (30-level sciences)—35% • prepare me to teach Science 30/Chemistry 30/provide information to help facilitate the implementation of the 30-level course/increase my understanding of the Science 30 program/give me a better idea of the new courses • enlighten me on the final changes to the new program/clarify certain aspects of the courses • provide me with knowledge/expand my repertoire of knowledge with respect to specific aspects of the science programs • improve my understanding of how all the science courses fit together to give a unified approach to science • answer some questions, raise some more questions.
Provide Teaching Strategies—21% • provide insight into how to teach the courses • provide me with some meaningful strategies that work in classroom/give concrete examples of strategies and materials that can be utilized • give me new ideas to be used in the classrooms/provide resources and ideas to help with this pilot program • show me new techniques/show me some new ideas as to how to incorporate current STS connections into the physics program/show me some new ideas for experiments.
Be Useful/Renewing—17% • be similar to previous year—I have benefited from previous sessions • inspire, rejuvenate and provide direction • be informative and useful/to help me • give me an idea and a sense of hope for Science 30 • informative and practical/enjoyable and informative.
Provide Evaluation/Depth Information—15% • answer questions re: evaluation (diploma exams) • clarify what types of things students will be expected to know for the diploma exams • clarify the depth that some of the topics will be gone into. Also, will the lab component be tested? • clarify our school's expectations of the new science program.
Provide Networking Opportunities - —9% • enable me to meet some of the other teachers and share ideas, concerns and problems encountered during the past years • give teachers a chance to discuss ideas/successes/failures/provide a chance to see how other pilot teachers are doing.
Other - —3% • to be even better than last year's—teachers in other curriculum areas are jealous of the great help we are receiving from Alberta Education so let's keep it up and turn them green • to be interesting but likely longer than necessary.

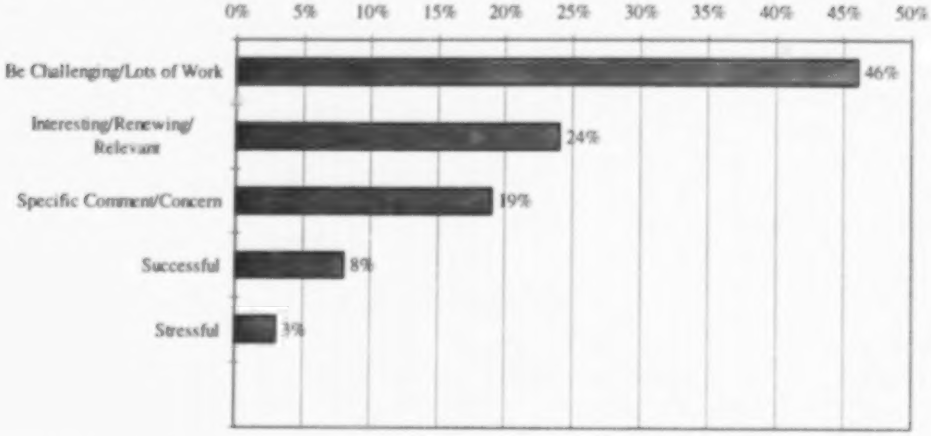
Teacher comment in this section showed a continuing solid expectation that the inservice would provide specific background for the teaching of the new 30-level sciences. The **Year Two** expectation for specific background was 12% higher than in **Year Three**, 47% compared to 35%, while the expectation for information and strategies related to student evaluation had risen from 2% to 15%. In **Year Three**, a substantial increase in interest in student evaluation and assessment was anticipated as all the 30-level science courses (graduation level) were to require students to wrote Alberta Education provincial diploma examinations that would count for 50% or their final mark.

Interest in teaching strategies had gone from 20% in **Year One**, to 8% in **Year Two** and back to 21% in **Year Three**. It is interesting to note that comments with a major focus on practicality (16% in **Year One** and 13% in **Year Two**) did not rate a separate category in **Year Three**. **Year One** and **Year Two** inservice sessions were planned and implemented with a strong focus on practicality and teachers were now confident that the sessions in **Year Three** would be equally practical. The comments in the teaching strategy and useful/renewing category contain a few direct and several indirect references to practicality.

The mention of networking opportunities rose from minor mention in **Year One** to 3.5% in **Year Two** and to 9% in **Year Three**. Over the previous two years, the cohort of field validation teachers were really getting to know one another and they had come to appreciate the valuable interaction opportunities the inservice sessions provided. Hence, many more were expressing anticipation of such interaction with the extended group of colleagues within this project. Networking was an informal yet important aspect of the inservice program with meal times, coffee breaks, unscheduled late afternoons and evenings, and travel times providing such opportunities. From the planning aspect we were careful not to overload the program and allow such "down time" so teachers could network and otherwise "recharge their batteries" in a variety of ways. Whenever groups of teachers jogged, walked, visited the bookstores/shops or simply socialized, networking resulted with the conversation often turning to professional matters regarding the implementation of the new science programs in their classrooms.

A fairly large number of teachers (17%) made comments indicating the expectation that the sessions would be both professionally renewing and useful—a category with a mix of references to professional development and practicality. A positive outlook I believe was built upon previous experience as shown in the comment "be similar to previous years—I have benefited from previous sessions" prevailed in the expectations expressed in this category.

Figure 5.15:
Year Three—Teachers' Expectations of New Course(s)
Percentage of Teacher Journal Comments by Category
The new 30-level courses will…



Sample Comments (76 comments were categorized and considered)

Be challenging/Lots of Work—46%

- be a challenge—this is the biggie! What is done here will shape the diploma examination which will shape and drive the 10 and 20 courses
- be challenging for teachers and students/be most challenging (and interesting) for myself and my students/challenge students and me
- challenge students to rise and meet course expectations/present a challenge regarding evaluation
- challenging to incorporate into the classroom and there will again be a lot of planning and preparation
- require a great deal of work/be lots of work
- require a real time commitment from me since I will no doubt have other new courses this year
- probably be as intense as the 20-level courses (particularly Science 30).

Interesting/Renewing/Relevant - —24%

- further encourage students to think, examine, get involved
- encourage me to teach from a new perspective with a greater sense of creativity
- be very interesting/be interesting to teach/be exciting to teach as long as there is enthusiasm towards the new material
- over time provide students with a more realistic view of science in today's world/provide students with clear evidence that science is relevant to "real life"
- hopefully prepare students to a greater degree for their future careers/better prepare and inform students
- better prepare students to be active members in a new techno-science world
- bring back a renewal and revitalization to science/inspire added interest in science
- be fun to teach, and also better able to prepare students for lives as science aware citizens

Specific Comment/Concern—19%

- I am concerned that there appears to be too many moving targets all at once
- be tough—too much content/will go well but I still feel as in the Science 10–20 that the Science 30 contains too much material
- relatively simple to implement (physics)
- using an experimental approach and being more process oriented is fine but the courses should also be for students who are not university or college oriented
- be a challenge but I am looking forward to them/be challenging but enjoyable (I hope)
- will not provide a lot of new content but should give a chance for more lab work and a chance to relate them to activities outside the classroom.

Successful—8%

- be okay/go well/probably work well/will be good.

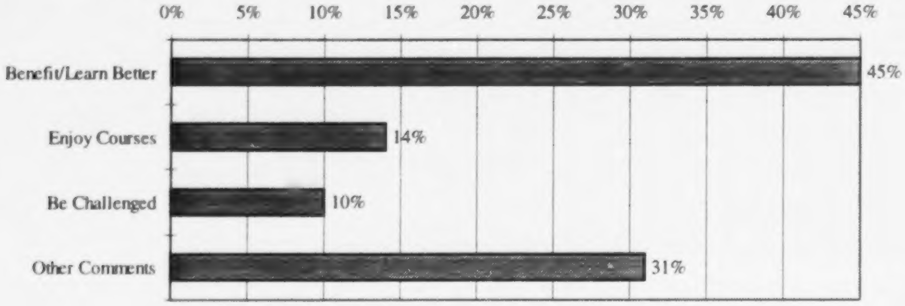
Stressful—3%

- will hurt/be worrisome until I get a sense of direction where the diploma exams will come in at.

In **Year Three**, the expectations of the 30-level courses were a little less positive in tone than in previous years with a substantial increase in reference to the challenge and hard work associated with field validation moving from 23% in **Year Two** to 46% in **Year Three**. The final year of the field validation was viewed as very important (diploma examination/graduation year) and requiring continued high energy effort with particular attention to evaluation/course expectations. About 25% of the commenting cohort expected positive professional development opportunities to be associated with **Year Three**—the 30-level implementation was to be interesting, relevant and renewing. Success of implementation was predicted by 8% while only 3% mentioned specifically that the implementation would be stressful. In the "other" category, concern as to the volume of changes being introduced and to an overdose of content and/or rigour in the new courses was registered. On the other hand, comments in this category indicated an expectation of ease of implementation and that change if a "good thing" (most of the time).

These comments told me as an inservice planner and the Science Team that the teachers were, as they faced **Year Three**, generally still supportive of the new program and that so far through their involvement in the project they had experienced positive professional development and seen benefits for their students. On the other hand, involvement in this project required tremendous effort, well beyond their normal workload and they were very aware that this final year would be even more demanding for teachers and students as the diploma examination development, field validation and graduation level accountability would be an added component. As these comments were made at the final inservice session for the project they were used to advise the whole **Year Three** segment of the project with special attention being paid to the likely need for additional support, understanding and patience from the whole science team as they worked with these dedicated and overworked teachers.

Figure 5.16:
Year Three—Teachers' Rating of New Program Potential for Students
Percentage of Teacher Journal Comments by Category
My students will…



Sample Comments (58 comments categorized and considered)

Benefit/Learn Better—45%
- greatly benefit from the knowledge/skills/STS connections presented in the course. Thinking skills are lifelong skills
- get more out of their courses as the material is presented with the STS connections
- notice and understand the significance of science-related stories as they take place or are discussed in the media. Perhaps some will go on in science at post-secondary level too
- get a new approach or two and hopefully benefit from this endeavor becoming more autonomous in their learning
- able to apply their knowledge and skills in day to day applications as well as to further their education
- hopefully gain a new and better understanding of the natural forces acting in the "real world" that are very abstract
- benefit from my increased knowledge/from my attendance here/by me knowing which direction we should be taking/from new ideas or techniques that I learn from these sessions.

Enjoy Courses—14%
- come to enjoy learning about the sciences/enjoy the new Biology 30 course
- enjoy science/enjoy the new courses
- love Biology 30, continue to enjoy Biology 20 and learn to really like Science 10.

Be Challenged—10%
- definitely be challenged along with their teacher
- challenged with the new curriculum, as I will be challenged also with all the work ahead of me
- need to work hard and diligently in order to be successful.

Other Comments—31%
- be able to meet the 30-level course expectations if they are ambitious and industrious, but will fail to adapt if they have low commitment and inconsistent work habits
- are going to get frustrated along with me the first time through until the bugs get worked out and corners smoothed off
- love the fact that they do not face a diploma/thrilled there is no diploma in 93/94
- begin to relax into learning chemistry as a process and let go a little of the past need to "learn facts"
- be few (in Science 30)/probably not take Science 20–30
- probably have to take chemistry, biology and physics instead of Science 20 because the course will be gone due to the useless text and the 20/30 split class scheduled for next year
- want me to express how full Physics 20 now is
- cope better than me
- expect a good background in all the areas of science

Comments in **Year Three** regarding expectations for students of the new 30-level courses remained mainly positive although the combined percentage of definitely positive categories (benefit/learn better and enjoy courses – 59%) was about 20% lower than the combined positive categories in **Year One** and in **Year Two**. A large number of comments were placed in the "other comments" category and these made very specific references to a variety of ideas. Some references were negative; the content overload, the frustration and challenges of the first time through new curriculum and a complaint about the Science 20 textbook while others were positive; love the fact they don't have to write a diploma, expect a good background in all areas of science and begin to relax while learning chemistry as a process. Again, substantial reference (10%) to the challenge of the courses and the associated workload appeared.

Year Three Summary

The final year of inservice activity for the field validation project brought a mix of teacher comments; relief that they could see the end to the exhausting pace of the last two school years and the year to come and yet regret that the professional development and networking opportunities the project had afforded would be drawing to an close. The University of Calgary provided an excellent site for the inservice and the facilities, amenities and social functions were all well received by the teachers. Detailed information on the field validation teachers involvement in the development of diploma examinations for the 30-level sciences was provided and the 40–40–20 issue was put to rest with the decision to keep the final mark for the 30-level science courses to be a 50% teacher awarded/50% diploma examination combination. A performance assessment was to be incorporated into the teacher awarded component. Calls for an increase in program specificity, for a clear indication of depth of coverage continued in this last year with renewed vigour as diploma examination anxiety caused teachers to call for exact indication of the expectations. The program of studies underwent revisions to clarify the intent and depth of coverage. Although teachers often felt the programs of study were not specific enough, the level of detail in them was much more than had been indicated in any previous science curriculum in Alberta.

The thorny issue of acceptance of Science 30 as a prerequisite science course for non-science majors in Alberta universities and for some science technology programs in technical institutes was raised by several teachers in several of the comment categories. The debate surrounding the "rigour" of the integrated science program as compared to the discipline science programs was strong at the time of the field validation project. In 1989 when the University of Alberta, the largest and oldest university in Alberta, first considered the acceptance of Science 30 much media coverage and public controversy surrounded the decision. The Dean of the Faculty of Science had responded to the Science 20–30 program as "the time magazine approach to science" and the university rejected Science 30 as part of qualification for admission to any U of A Faculty (Alberta Report, 1984). The magazine article that covered this issue and contained the Dean's quote is presented in Appendix I. It was the University of Alberta's rejection of first development of the strong integrated science and STS focus Science 10–20–30 program that resulted in the Alberta Education development team completely reframing the program—the first version was scrapped and work to develop the program once again began. Although the University of Alberta did finally accept the redrafted Science 30 all of the negative publicity had created a very bad image and the damage had been done to public perceptions.

The Alberta Education position is that the Science 20–30 program is of equal academic rigour to the discipline science routes—what it lacks in depth and detail it makes up for in breadth and interconnecting science principles and process that cross discipline boundaries. Science 30 is designed to prepare students who are not going on to specialize in science or engineering for careers and for life—to better prepare them than any single discipline science would, by bringing the principles of physics, chemistry, biology and earth science to bear upon real life science and technology problems and science-related societal issues. Some progress has been made but the publics acceptance of Science 30 as a viable alternative science course for graduation for those students entering non-science routes at post-secondary has not yet been attained. Science 30 is currently accepted as a prerequisite for many more post-secondary programs than most students and parents realize. However, even after extensive communication with school principals and student counsellors explaining the possibilities, misconceptions regarding the acceptance of Science 30 prevail. Students and their parents are choosing the discipline sciences over the integrated program as they feel a discipline science(s) keeps more doors open for the student. This is presently true as there are very few first year university science courses that do not require a discipline science as a prerequisite. As a result, enrollment in Science 20–30 is much lower than anticipated and the program is just holding its own. A core of field validation teachers and administrators who are committed to Science 20–30 as the best route for students going into the humanities and other non-science areas are strong advocates for the new program. They, along with other administrators and teachers who now believe in the program keep it going in their schools and work with the school counselors and the school community members to assure Science 20–30 is presented to students as a viable option.

Several references were made to content overload in the new programs, some with the implication that the new program was overstuffed to satisfy the universities' concept of "academic rigour" rather than the students need to truly understand and apply basic principles of science. Some content was removed from all of the new programs as a result of the teachers feedback on the formal field validation response forms and their comments in the journals. Revisions made at the 30 level resulted in revisions to the 20-level courses and in several cases to the Science 10 course as it provides the foundation for all of the 20-level courses.

One teacher in **Year Three** commented:

> *I want to know* if the teachers implementing Science 10 this school year and facing the 20-levels next year are feeling as stressed and angry as we did in session one in Edmonton (before we began)? Was that a one time phenomenon or is the anger necessary before you can let go of the past and accept the future?

This comment brought the often painful process of change into question. She wonders if the initial anger, frustration and stress she experienced are always part of the process of change. This particular teacher was called upon to present a personal perspective of her Science 10 field validation experience to the Southern Alberta field validation teachers who gathered in Calgary at the callback session in January 1991. She did so in a manner that conveyed the anger, frustration and stress of change yet also communicated her fine sense of humour, balanced perspective and belief in the potential of the new programs that carried her through.

Workload Woes

Just as the teachers involved in the field validation project, the Science Team members had a huge workload to juggle as they worked with the teachers during the field validation period. While doing the more tangible work within the project they were also expected to maintain a positive attitude and provide leadership by example. Mutual respect developed between the teachers and the team as they both worked extremely hard to field validate the new programs and resources, to develop new resources and to provide professional support and leadership. The team members worked smoothly together, turning to one another in times of stress. They shared the challenge of ongoing responsive revisions to programs and resources, of developing resources within tight timelines and of providing strong support and leadership for the field validation teachers. Great respect for the various abilities and perspectives of each team member developed among the team as the team members expertise, experience, energy and commitment was pooled to accomplish this massive implementation and inservice project. As reflected in the teacher journal comments, particularly in **Year Three**, the teachers developed tremendous respect for the Science Team as the project progressed. With the development of trust and rapport the project the teachers became more tolerant of the many minor and even major challenges that were part of the field validation project. The major challenge was the very heavy workload associated with the field validation project. Minor irritations like unseasonably dull, cold and snowy weather for the geology field trip in **Year Three** caused little complaint by the teachers. Even an unexpected twenty-minute delay in the trip departure, with all 170 participants sitting on buses waiting for boxed lunches to be delivered, did not deter the enthusiasm of the participants.

The field validation teachers also developed a real sense of respect and appreciation for one another through project involvement; a real sense of camaraderie. Teacher networking became more important to them each year; they developed professional and personal relationships with teachers they might never have otherwise met. At the last inservice session in **Year Three**, numerous teachers spoke to me and other members of the Science Team expressing regret that the inservice sessions would not be happening in the next year - they would miss the professional development opportunity and the colleagues they had been networking with over the duration of the project. Several requested continuing sessions if at all possible.

Journal Comments Provide Added Dividends

As previously mentioned, the journal analysis just presented was limited to the first *Initial Perceptions* page and yet much information useful to inservice planning and the implementation of new curriculum was gained. The *Initial Perceptions* page provided a window on the teachers thoughts, feelings and hopes regarding the inservice activities and their involvement in the field validation process generally. The teacher journal comments in this section of the journal along with their comments on every workshop they attended at the inservice session informed not only the inservice planning process but curriculum and resource development, communication planning and provincial implementation planning.

The other sections of the teacher journals, although designed to provide evaluative data on particular workshops, often provided teachers opinions and feelings on a variety of other matters. The freedom of the completion format encouraged them to work on whatever was on their mind. For example a teacher made very positive comments regarding a workshop on technology that had included a demonstration of laser disk technology. That teacher wrote in his journal of the frustration he felt due to the lack of technology within his school and of the bleak prospects for ever obtaining any. Comments such as these prompted us to have teachers from schools with a strong technological focus provide information on how technology became an important and supported priority within their schools and/or school jurisdictions.

Parallels: Parenting and Planning

During the inservice project I often saw parallels between the role of a judicious parent and my role of an inservice planner with this project. Although I will point out several of these parallels, I acknowledge that there are also many important differences. Both parenting and planning and implementing inservice activities are complex activities involving many more individuals and variables than this simple analogy addresses. However, a strong sense of common purpose and belonging, a sense of trust and rapport—similar to what one often finds in close families—developed among the field validation teacher and the Science Team as what we worked together over the three-project period. For this reason, I draw these parallels

Family life and the major curriculum change implementation are both high stakes endeavours affecting the personal or professional growth of parents/teachers and ultimately the development of children/students. In a centrally developed curriculum implementation there is a politically accepted framework for the curriculum change that must be honoured. In the Senior High Science project this was the vision and the philosophy and rationale for the new science programs; the major program directions including strong focus on skills, STS teaching strategies, integration of disciplines around overarching themes of science and broadening of traditional evaluation practices to provide more authentic assessment. In a family such a framework is provided by the parent(s) in the form of the core values they communicate to their children; the rules they wish them to live by. Boundaries or limitations, what is negotiable and non-negotiable, are set by the parent or in the case of curriculum change by the central agency implementing new curricula. Boundaries can be set through varying degrees of consultation, within the family or within a curriculum development process. Consultation and negotiation, if allowed, can affect the degree of accommodation that can be made within the family structure or the proposed curriculum change.

Just as in a family a centrally developed curriculum must work within a defined budget and this budget may vary from year to year depending on circumstance. Judicious parents do the best they can for their children with the resources available just as a central curriculum development agency must do the best it can to supply the resources required to support teachers implementing the new curriculum.

Based upon my experience with my own family and the Senior High Science inservice project, I see the following factors as important to the success of both:

- mutual trust and respect
- ongoing, honest and open communication
- communication and understanding of the reasons for values/actions
- encouragement of reflection, exchange of ideas, open-mindedness through provision of strong models and an environment conducive to these activities
- respecting other points of view, valuing their experiences and tempering ones actions and views accordingly within limits—response to concerns is essential
- flexibility, allowing for changes along the way to bring progress more in line with the vision/core values
- awareness of budget limits/support provided as far as budget allows
- attention to physical and emotional well-being
- model and promote a "learning is for life" attitude
- positive feedback/recognition of efforts and accomplishments.

Perspective Three: Science Team Reflections

Background

A group interview with the Alberta Education Science Team members' was conducted to gain insight into their perspective on the three-year teacher inservice project. The summary of their interview comments provides the information needed for discussion of their perspective in relation to that presented by the teachers in their journal comments, and to my perspective as project manager. The Science Team was an essential and integral part of the inservice project, providing ongoing leadership and collegial support for the project teachers. They provide an important voice.

In this 1½ hour interview, several questions were posed and each team member responded to each question in turn. I was confident, knowing this group well, that this method would bring out more ideas and recollections than individual interviews. Team members would build upon each others' comments minimizing repetition or would add a comment in a different direction expanding into other topic areas. The synergy of the group would increase the depth and diversity of comment obtained.

The complete interview was videotaped and audiotaped for later analysis. The videotape of the interview turned out very well, while the back-up audio tape was of poor quality. My original plan was to view the videotape several times and write a summary of the interview under particular comment category headings; topics or themes that would emerge as I considered the many comments made. After reviewing the videotape several times, I found that it was very difficult to keep track of all the comments by viewing alone. To address this problem I transcribed the whole interview from a second back-up audiotape that was produced directly from the videotape. The videotape was very useful in providing the added dimension of body language and voice inflection, and the impact of the video viewing added an important dimension to the interpretation of the interview comments. A list of interview participants, the letter of invitation and the interview consent form, along with the complete interview transcriptions is presented in Appendix B.

To refresh their memories, Science Team members were provided with a background package of information on this inservice project that had been completed three years earlier. This package, presented in Appendix F, included letters, inservice agendas and other information on the project that were provided to the field validation teachers over the duration of the project.

Only three of the nine Science Team members were with the Science Team full-time throughout the whole three-year project. Five returned to classroom teaching and one to teaching and research at the university. Several members, although not continuing their Alberta Education Science Team duties full-time, continued as contractors after teaching hours and during the school break periods in July and August. One member was present only for **Year One** of the project and another only for **Year Three**. All team members, except one, were from the Curriculum Standards Branch. That member was from the Student Evaluation Branch and joined the team for **Year Three** of the project.

One team member was unable to attend the scheduled group interview session and was interviewed two weeks later using the same format and questions. This individual's interview was audiotaped and the member's comments were transcribed and placed under the appropriate question headings in the group interview transcript record and were considered with the comments of the rest of the interviewees.

After completing the story of the inservice process from my perspective, and from the field validation teachers perspectives, I drafted some interview questions. I believe that by leaving the Science Team interview to the last I was able to build upon my previous research experience and draft a more informed array of questions than I could have previously. I modified the original planned questions during the interview process in response to the direction the comments were taking. In the end, the actual pre-interview assignment and the four questions posed were:

Pre-interview Assignment
Please bring to the interview three words or short phrases that capture important aspects of **your** experience of the inservice planning, implementation and leadership process.

Question 1
When you think about the actual inservice planning process what do you recall and would you have any comments about that?

Question 2
I'd like you to think about your own specific role at the inservice—what you did personally.

Question 3
I'd like a quick comment that focuses in on the teachers' journals.

Question 4
If you could have unlimited freedom and resources, beyond what we had available for this project, what would you wish for the inservice component?

Group interview participants' comments did not always relate directly to the four questions posed. Interview participants often extended their comments into related areas. Review of the interview transcript revealed relationships among comments made in response to a particular question, among comments made regarding two or more questions and between comments that did not relate to any specific question. After viewing the videotape and transcript several times, I began to group the comments into categories based upon themes or topics that were identified. These major comment categories and their associated comments were then reordered to convey the findings of the interview analysis in a coherent manner. The major comments categories used in this summary and discussion are:

- The Inservice Challenge
- Leadership
- The Strategy: Dynamic, Reflective and Responsive
- Positive Shifts
- Balancing Politics with Teacher Practice
- Exploring Future Possibilities.

The summary uses bulleted interview participant comments within each major comment category section. Closely related comments by other participants are sometimes included within a bulleted section and are separated by a slash (/). In order to present the essence of the comments made in a concise manner, phrases or words were eliminated if they served only as conversational bridging statements or if they did not provide information specifically related to the project. In some cases, words or phrases were reordered or words were added to improve clarity for the reader.

The Interview Begins

The interview began with a sharing, without discussion, of the three words or short phrases that captured important aspects of each interviewee's experience of the inservice planning, implementation and leadership process. The words and phrases provided were:

- unprecedented and unmatched change, leaping the chasm, success and its prerequisites
- the learning cycle—I thought that it was a significant insight that we and many people gained into the implementation of the program
- historic, exciting, frustrating
- innovation, commitment and challenge
- enthusiastic when I think of the teachers that were there, extremely motivational for the ones that were there and myself and very informative

- the two things that struck me most was the change and all the things that happened around that change and the close knit team that was working in Curriculum on the project
- trepidation or apprehension, anticipation and collaboration
- pleasure at the fact that you were involved in orchestrating it and satisfaction from the feedback I heard from the people participating in it and that it was going so well.

In these introductory perceptions, the Science Team members speak to the challenge of the change and a strong sense of mission emerges. The recollections reflect tension—enthusiasm and anticipation contrasted with apprehension and even frustration. The collaboration and support among members of the Science Team and the focus on success is evident.

In **Year One**, the field validation teacher's journal comments reflected a similar ambivalence as the project began—teachers expressed excitement, anticipation and varying degrees of support for the new program directions while also expressing anxiety, insecurity and doubt about how they would be able to cope with the changes. In their **Year Two** and **Year Three** journals comments reflected the development of a real project spirit and appreciation for the collaborative manner in which inservice sessions were being planned and implemented. In **Year Three**, the comments indicated that the Science Team and field validation teachers were working as colleagues sharing the leadership, responsibility and success of the implementation.

Interview Summary and Discussion

The Science Team members' interview comments (bulleted), sequenced and grouped according to the comment category framework, follows. Discussion of their comments in relation to the teachers' perspective and my perspective as project manager is interspersed throughout.

The Inservice Challenge

Mission Defined

The Science Team describes the challenge of planning and implementing inservice activities that would result in changes in teacher practice to support the new curriculum:

- the scale of the whole operation that really was historic in terms of the size of the field validation that was undertaken
- planning allowed us in to try and "bridge that chasm". There was a lot of resistance to the change, it was a very controversial change, it was representing a totally new paradigm and we were asking people to make that change
- how do we provide the teachers with the necessary capabilities to deal with the Senior High Science Program Vision Statement (Appendix G) for the new science program. The word Vision was used to encompass a whole constellation of things we were trying to do with the new science programs including the redefining of the concept of nature of science. Bringing in STS is a very important part of that as was a new definition of what we think the learner is—when you take those two together you change the nature of science education—you talk about activity based learning, something much broader than simply the teaching of the knowledge component of science

- we had to win people over. One of the significant hurdles was to demonstrate that there was a commitment by Alberta Education to support this change and get the teachers involved up to speed. In the planning process, I think that was addressed in terms of looking at having high quality inservice activities as well as social activities where people could become comfortable with the group and the programs. The planning process was very thorough and inclusive, covering all the bases
- that's where my word challenge came from—the challenge being to offer the teachers what it is they require to make this shift in presenting the subject matter and the kind of teaching methods and approaches they needed to adopt for this program. Working with what in comparison is the black and white part of the sciences presented a different challenge because until very late in the process there was a certain antagonism towards the topic—physics and mathematics seem to create an anxiety in people that had to be won over or overcome and presented as a result an additional stumbling block to the acceptance of the change.

Teacher Resistance/Team Reactions

Teacher resistance was anticipated given such extensive changes in the curriculum. It was directly experienced in various ways by all team members at the inservice sessions. Although the team mentions the eventual sense of accomplishment and reward (they maintained a strong sense of Mission) their comments tell that the teacher resistance caused them considerable frustration and anxiety. Such experiences of teacher resistance, although unpleasant, provided team members with direct information on teacher issues—information that could help us decide which issues were common and/or important enough to be addressed in future session planning.

- Some frustration and some tension comes whenever you make a huge change—there is always a faction of resistance from various areas, there was pushing and shoving on you from all different directions and that is what forced the Science Team to get into such a tight team.
- The work itself was very rewarding. I found it was frustrating at times as we were scrambling to think of what was the best way to forward our thoughts on the program and bring teachers around to except the changes, but I found it very rewarding
- There were frustrating times dealing with teachers who were very rigid in their points of view and who were upset because their old world had crumbled around them—physiology was no longer biology and how were they going to cope with things that they had always dealt with being gone. In most of the teachers that attitude had almost disappeared by the last inservice—there still were a few remnants, like pockets of resistance in a war where they just have to clean them up a little bit
- The frustration of the exercise for me, particularly in the Science portion of the course was that people expected to have activities that were verification activities, experiments that always give you 100% success. I am sure that I antagonized many by insisting that all experiments work—it is just that you have to look at your results and interpret them appropriately. If they aren't the results you expect and you then ask the question "why not" and take that into a learning experience.
- I was so excited about the new test management computer program *(LXR-Test)* that would do all these great and wonderful things—making up tests and quizzes and about how much time it would save me if I were in the classroom. I was excited about trying to get these schools to

work together to develop exams and a shared pool of questions. I then realized that many teachers were far behind where I was in the technology area and that they weren't near as excited as I was. That was a bit disheartening, realizing that there were people in my workshop and in other sessions who had negative reactions to things—who were very nervous about the new programs and didn't want things to change.

- In the first year of the planning, I was very apprehensive about how the teachers were going to react to everything. There had been so much negative feedback and nervousness about the programs that I was a little bit afraid or nervous about how everything was going to go: did we think of everything, did we have everything planned, were there going to be any glitches that would come along that we hadn't anticipated. I had never been involved in organizing or planning anything of this magnitude before. I was excited about the whole thing because we had spent so much time and effort getting everything organized—the Teacher Resource Manuals and setting up all the speakers. I was really looking forward to sitting in on some sessions to see how it would all go. The second year I was a lot less nervous—a little bit concerned about locating the inservice in Lethbridge because arrangements for proper activity session equipment is much more difficult when dealing with people that are hundreds of miles away. As it turned out everything went fine in spite of the planners (us) being in Edmonton. I really looked forward to the **Year Three** sessions because at that point I'd taught Science 10 and Science 20 and had implemented some of the strategies we had presented in the first two inservices. I looked forward to spending time with my school colleagues and also to getting some new ideas or suggestions from the sessions—not having to worry about all the planning and being able to enjoy it for a change.
- It was really tough. At first we went through what you folks in the Curriculum Standards Branch went through because of change but to a very much smaller degree because you had made the big change. I got questions like "what is this a social studies examination?", "is this an English examination?" and "why are we going to these open ended written response items?" during some of my presentations. So we had to break some new ground but not nearly to the same extent.

Leadership

Science Team Leaders

The fact that all Science Team members had recently been classroom teachers and that five of nine of them returned to the classroom to implement these programs while still working with the team provided valuable grounded insights into the needs of the teachers we were planning the inservice activities for. The credibility team members had with other teachers was high—their classroom experience contributed significantly to the respect they received from the teachers in the field. Their leadership was grounded in classroom practice and prompted more open, honest and fruitful communication between the Science Team and Alberta senior high school science teachers. Teacher comments generally reflected a high degree of respect and appreciation for the leadership the Science Team provided, particularly in the **Year Two** and **Year Three** journals.

Inservice Project Leaders

My strategy as inservice project leader was to really tap into the expertise of the team in the planning and implementation of the inservice activities—to plan in a very collaborative manner and have team members play a leadership role in the sessions. However, because this team was also the curriculum and basic resource development team they were extremely busy people. I had to maximize consultation and yet minimize the demands on their time and energy. I did this by developing draft action plans, agendas, possibilities for them to respond to. In a very open, brainstorming mode we would work together, starting with what I brought to the table, to develop a plan of action that everyone was comfortable with. Once agreement was reached I would handle all the logistics to bring the plans to fruition. The process was ever evolving and provided for problem-solving sessions when obstacles were encountered and revision of plans in the light of new circumstances. It worked very well from my point of view. The comments of the teachers indicated that they were generally pleased with the results of the planning and that the inservice sessions were meeting their needs. The Science Teams thoughts on this are:

- planning is really closely intertwined with your leadership in this whole project. You gave us the freedom to just dream up what we thought was good while at the same time you were bringing forth ideas for us to consider and facilitating the work we were doing
- your role was certainly pivotal in planning the inservices and I think each of the consultants had a very major role in terms of planning the specific activities
- really glad you were running it because of those spreadsheets that you had keeping track of all of the teachers and setting up the sessions. With all the sessions going on I was glad you were working on that part and I only had to work on my bit.

Team Collegiality

The Science Team members were committed, hard working, dependable and respectful of each others' expertise and view points. They shared a passion for the new curriculum Vision they had helped develop. They were eager and willing to assist teachers to make the changes needed for implementing the new programs. Team loyalty and trust was high—they had been through a lot together—yet they remained an open and responsibly reflective group—open to one another, open to the project teachers, open to the political realities and to all the other education stakeholders we were working with. The Science Team shaped, fine tuned and communicated the Vision and the new curriculum through the lens of their teacher practical knowledge and the insight gained through very effective communication with Alberta science teachers, particularly the field validation teachers. They managed to assure, in spite of much buffeting by political winds, that the Vision and the new curriculum had integrity with teacher practice. It was a difficult and very important balancing act that the team performed with great success. The project was very much a united group effort with teacher interests at heart.

- It was the first time I had worked in a group where nobody fought and everybody worked for the common good—it was probably the most rewarding experience in terms of group work and effort I have ever been involved in.
- I was struck by how close the team was and how well we worked together/I can't emphasize enough the team effort that was put into the planning/I would echo the pleasure of the group work/I got the benefit of most of that cooperation because being responsible for Science 10–20–30 I had overlap with all of the disciplines.
- In terms of the personal dynamics that you may have not seen from the inside - you had an "us against the world" attitude when I joined the team. There was a bit of "group think" happening—you wanted to defend what you were doing because you had put so much work into it. All in all you made a great team and you made some great changes against a lot of obstacles.

- We would share that anxiety and spread it amongst the group and go in each supporting one another/if somebody (a team member) phoned and said we need you I think we would all be there on the doorstep to do it all again and that's quite amazing.

Roles: Listen, Observe, Lead, Collaborate

- To listen to what people are actually saying and engaging folks in dialogue to see how things were coming along. I asked them " how's it going" and what things had been working to get a sense of where things were at. I tried to gauge the impact of the inservice activities on people and trying to see if we were on course in terms of how things were actually changing—were the activities being framed to provide those important major links among the different sciences and what was the big overall plan for **Year One**, **Two** and **Three**.
- Being someone to listen. The three- or four-day inservice sessions provided a more thoughtful environment in which you could discuss with individual teachers what it was that was bothering them or what it was that they liked about the program—not nearly as confrontational as the one day information sessions we did with groups of teachers where I felt more like a lightning rod then a listener. You could work out things and learn from it and I think the teachers could learn from me as well *(At the inservice sessions).*
- The role of observer, particularly in the first sessions at the U of A was an interesting one. The role of observer—I was curious to know what these teachers were thinking and how they were internalizing the massive changes and it is more in retrospect that I began to realize how massive those changes were. We had this naïve notion that they would see all this great stuff and just go ahead and teach it. It was fascinating to observe how different individuals reacted—how different personalities adapt to change. Trying to incorporate some of what I observed at the first inservice into some of the things I thought we should be doing for the second or into our documents—sort of adjusting to what I observed there.
- A leadership role—people looked to me as the person who knew something about the changes, particularly in the chemistry area. I was less comfortable with that because when I hadn't actually gone out and taught the new curriculum in the classroom and I didn't feel real comfortable standing up there and saying it was really good stuff. I used some overhead transparencies I put together to help me show you could organize a course around unifying themes like energy, matter and change… how you didn't have to organize around chunks of disciplines. That concept seemed meaningful to a number of people as they hadn't really thought of how such themes run through all the disciplines.
- The hands-on involvement of the sample activities—that was more satisfying to me personally. The hands-on work with the materials. I always dealt with the unit that wasn't specifically related to biology, chemistry or physics—Unit 1 of Science 10 and Science 20 and Unit 4 of Science 30, and I enjoyed working with that. Good university people with a particular interest in the earth science, meteorology or the energy field worked with us on those integrating units.
- In **Year One**, I was making sure that everything was OK in the sessions, that everyone had what they needed, including the coffee and muffins. This was the year where I did a technology session in the IBM lab and the LXR-Test workshop in the Mac computer lab.

Team members were committed to observing and listening at the inservice sessions—to draw out and hear the concerns and comments of the field validation teachers, to look for clues as to how things were working and what we could do better next time, to provide what was needed to optimize teachers' learning experiences in the sessions. In the leadership role they were cognizant of teacher reaction and always eager to improve interaction in the sessions to help determine how to best meet the needs of the teachers. The inservice sessions provided a valuable block of time for team members to maximize formal and informal communication with the teachers. Such direct communication provided the team with important information they needed to fuel their reflective and responsive process of inservice planning and implementation. The teacher journal comments in **Year Two** and **Year Three** expressed an awareness and appreciation of how the inservice session planning addressed concerns previously expressed in their journals.

Team Leader's Professional Growth

- In retrospect, the overall personal satisfaction was the amount of learning I was able to do through this particular process and I wouldn't even think twice to do it again.
- I don't think I have ever been involved in such a mega-project that was so rewarding and I learned so much, I just learned so much.
- It was exciting to learn about these disciplines—more things than just the chemistry that I had been working on.
- At a Student Evaluation Branch meeting we just commented about how when the new courses were first being implemented was one of the best times the branch has been through because we all had to get together and compare our philosophies—it is still being done now but we have to avoid falling into the rut of being satisfied with where it *(student evaluation/the diploma examinations)* is now and keep hammering away at each other.

Team members were on a steep learning curve as they learned by doing and by experiencing - the same method the new curriculum was advocating for students. Active involvement in curriculum and resource development, in learning science beyond their discipline areas, in providing leadership, in collaboration at many levels, in discovering the political influences on curriculum, in helping create alignment between curriculum and evaluation—the list goes on. They provided strong models of lifelong learning. The reflective and responsive mode in which they worked led to better decision making. The Science Team really "walked the talk" and that their actions reflected with integrity what the new curriculum called teachers and students to do.

The Strategy: Dynamic, Reflective and Responsive

The inservice and implementation project was from the onset a very dynamic process. Decisions on inservice activities from the initial general planning framework to the specifics of individual sessions were always open to discussion in the light of new information or ideas. The Science Team operated in an environment of ongoing reflection, discussion and decision making that provided the flexibility needed to respond to the needs of teachers, students and the changing political directions. Good communication with the field test teachers was critical to all aspects of the project and was maximized through the use of teleconferences, written feedback forms, telephone conversations, fax machines, the teacher inservice sessions and especially the teacher journals. Communications with teachers, formal or informal, were shared and served to inform all aspects of the project—the development of the curriculum, the resources, the evaluation instruments and the inservice program.

Teacher Journals

As the project manager, I was seeking a practical and effective method to gain insight into the project teachers' needs and response in regards to the inservice sessions. The teacher journals seemed like a good tool to accomplish that task. I had anticipated initial resistance to the journal writing activity but wanted to give it a try—if it hadn't worked we would have found another way. The ambivalence to the journal writing activity is reflected in the teams' comments.

The journals had a double benefit—they provided the feedback we needed for inservice planning and also prompted teachers to critically reflect on their beliefs about science teaching and to compare them with the new program directions. Journal writing provided the teachers with forum for self-dialogue—fertile ground for the beginnings of shifts in classroom practice. The teacher journal comments were a primary source of data that served to inform not only the inservice planning process but also the curriculum and resource development projects.

- Use of journals was an innovative and good idea. Journals were important in that they allowed folks to critically evaluate what they had done during the day and put something down on paper, and more importantly for me, given the task of ensuring that we provided good inservice activity, was an opportunity to scan the journals and determine what people were thinking and make changes as appropriate. Journals were an excellent planning tool for seeing where we were and where we needed to be.
- Any time you give teachers an opportunity to reflect it's a good thing—by formalizing that reflection process, teachers were given an opportunity to...one, give feedback to you and the Science Team and, two—they were also speaking to themselves, going over things that were running though their mind that they may have said to someone or were thinking of late at night. Journals provided an opportunity for them to write it down and reflect upon it—anytime someone has a chance to reflect on something they internalize what is happening better, they feel more comfortable with the things going on around them, so I think journals are a very good tool. On the negative side some people don't like doing journals. I detected that in my observations of the teachers—some of them considered it not a useful activity. However, I still think that even for those, by forcing them to do a bit of reflection it was probably a positive for them in the end and if you went back to them later they would probably say that.
- Teachers were reluctant to take this on but once they got into it I think they thought there was some value in reflecting—that it was good to think on these things. You were then essentially thinking about it and making some notes for yourself and in that sense it is probably symbolic of the whole change process—that once you get into it there is more there than you thought and you can get something out of it if you take a good look at it. The journals kind of reflected the whole change process and prompted looking at things in a new way and people were surprised at what would come of that.
- I am one of the people who would feel that writing a journal is not an activity that I would keenly participate in during a public forum. Having said that, I think, that as the observations made, by forcing people into it that advanced their learning in the sense that they did take a look at what happened during the day and how they reacted. For some of them it was just an opportunity to just "vent their spleen" which was a good thing as well because it made the next day that much more productive. In terms of the formalization of writing a journal I would still say that those kind of notes speak to myself—I guess I like to keep it to myself...but it was an excellent exercise.

- It was nice to read through the comments, sometimes to be validated that yes, what we were doing and what was happening was good and it was working, and sometimes it was good, although difficult, to read that what you thought was terrific was really not that great so we had to retool a bit. We had to reflect on what they were reflecting upon if that makes any sense. If we were told by 20 or 30 teachers that they had trouble with a particular aspect then we had to stop and think that maybe there is a problem here.
- The first year I heard a lot of negative comments about the "what use are these things" and "why do I have to sit down and waste my time doing this" and then I heard how that changed over time. By **Year Three** people would just be writing and writing because they had so much to say about sessions and they were so much more positive about the inservice and about journal writing. I think probably some of it had to do with how hard we *(the Science Team)* worked to change things according to the feedback that they gave us and how we tried as much as possible to plan to meet the needs they expressed.
- What you did was force the teachers to model a strategy that would be good to have their students use. I found when teaching I initially had to force students to do it but once they did it they thought, "hey, somebody is actually taking time to read these and listen to what I think"—there is a huge satisfaction from knowing that somebody is listening to what you say and responding to it. I don't know if it worked the same with these teachers or not but it really works with students and hopefully by doing it themselves they *(field validation teachers)* would see the value with students. That would be wonderful.

Clear Communication on Evaluation Critical to Implementation

The ongoing communication Student Evaluation established with the field validation teachers led to the collaborative development of new directions in the assessment and evaluation of the new programs. Such collaborative development resulted in evaluation instruments that met both the curriculum objectives and the needs of teachers. The inclusion of the Student Evaluation member on the team was a critical step toward the development of the essential coherence of the new curriculum with the new Diploma examinations. The reflective and responsive mode used in the examination development process reflected and complemented the method used throughout the project.

The teachers' journal comments indicated they placed high priority on the diploma examinations. They wanted assurances of congruency between the new curriculum and the diploma examinations planned for the new programs and requested immediate and detailed information on the exact nature of the examinations. Such information was difficult to provide as the examinations were to develop and evolve with the help of these field test teachers—they were to help shape and field validate these instruments. The teachers also requested extensive inservice on new strategies to help them assess the broader outcomes of the new curriculum. Evaluation and assessment were a primary focus area at all three inservice sessions.

- My job was to try communicate to the teachers how evaluation (particularly the diploma examinations) would fit in with the new curriculum and to observe how the teachers were viewing that and to see how fast we could go in evaluation. I had a very attentive audience because they really wanted to know what was going to happen with evaluation. I was new to the project and was just trying to wrap my mind around how to make the exams as forward thinking as the program of studies—to reflect the program of studies. I learned a lot and the teachers were very receptive. I found that with few exceptions they were willing to try to innovate on the evaluation side of things too. That was a valuable lesson to go to the field and try to learn what they wanted for the evaluation and at the same time try to communicate how the evaluation was going to parallel the program of studies.

- a serious point that did come up occasionally throughout this process is that sometimes we weren't saying the same thing out of Curriculum Standards and Student Evaluation. Part of that has to do with just the way our organization *(Alberta Education)* is structured. I sometimes felt that some of the folks in Student Evaluation were just a little bit behind in saying what we were saying and part of that was that we weren't getting to work together enough because of the structure of the organization. I think the organization has recognized that and has taken corrective measures—we are working far more closely now than we have ever done previously—a very good sign.

Project Duration/Participants

Working with a group of teachers whose core composition was relatively constant over the three years of the project was a great advantage. It provided an environment in which teachers could network with other teachers over a long time period regarding a common event—implementation of the new program in their classrooms. It gave the time needed for a real momentum to develop, a commitment and group spirit to emerge. The Science Team had the opportunity to get to know each teacher relatively well and to identify their strengths and weaknesses. That assisted in the planning for specific support mechanisms even for individual teachers and the identification of solid teacher leaders for the inservice sessions. The fact that the field test teacher cohort reflected the diversity of the teachers in Alberta provided for a more authentic field test.

- Having the group that we did over the three years really did cause change in the way that a lot of these teachers viewed everything from teaching strategies, thinking about what's best for the student and spending more time on labs and process skills and changing evaluation strategies—kinds of things that even when I am supervising student teachers right now that I don't see happening with the high school teachers generally, at least it is the rare one that has made the kind of gains that we had (with the field validation teachers).
- Field validation teachers were selected deliberately to reflect the broad range of classroom teachers that we had in Alberta.

Physical Environment

- If you keep people reasonably comfortable and feed them well they are perhaps more eager to show up the next day to do things.

Teacher journal comments clearly indicated how important it is to provide good accommodation, food services and amenities. Any failure to meet minimum expectations resulted in complaint and negative attitudes and teachers less receptive during the inservice sessions. When teachers were well rested and well fed the whole atmosphere at the inservice sessions was more positive and teachers seemed more receptive.

Communication Results

- The Science Team knew everybody because you worked with the teachers so much that you knew where they were and what they taught. You were totally involved with the teachers that were participating in this (from Student Evaluation Branch member who joined the team in **Year Three**).

Positive Shifts

The reflective and responsive mode of inservice planning began to produce positive results. The extensive communication with the field validation teachers and responsive action to their expressed needs resulted in trust and rapport developing between the team and the teachers. Teachers gained experience and more confidence with the new programs and teacher leaders emerged and were brought in as inservice leaders. An atmosphere of collaboration toward a common cause developed. The diploma examination development involved much more collaboration between the Curriculum Standards Branch and the Student Evaluation Branch and the teachers than previously with good results. The positive shifts toward acceptance and implementation are evident in the teachers journal comments as they are in the Science Team comments that follow.

Acceptance, and Ownership and Momentum

- It gained momentum with each successive session. U of A was a lot of frustration, a lot of the teachers getting to find out what this was about and being kind of shocked at how much work they were going to have to do and then Lethbridge was surprisingly better than we thought and Calgary was a great way to end the whole thing.
- I really remember the University of Calgary in the last year—the tours and how wonderful they were and the whole change in atmosphere. I started to feel much more of a colleague with the other teachers instead of one of these Alberta Education personnel. I don't know how much of it was because I'd been back in the classroom and how much of it was just a real change in attitude that the other teachers had—there was a lot more excitement about teaching the programs and the opportunities that it could afford to the teachers.
- The other part was just seeing that things were just moving along well and the teachers were starting to "buy in" to the whole concept that was being presented to them, they were starting to accept the change. The journals partially reflected that—you probably looked at them in more depth then we did, but I think that the journals reflected an evolution of acceptance from the very beginning to the end.

Teacher Confidence

- I loved to watch the teachers unlock their potential in the sessions, particularly in Lethbridge and Calgary ones, where teachers started to realize that they could do all these things and it wasn't as scary and they had the potential and knowledge and ability to do it. It was nice to listen to the teachers dealing with change.

Shifts in Leadership

In the **Year One** inservice sessions, leadership was provided by the Science Team and by a strong core of school and post-secondary educators that the team identified as having strong skills in strategies supportive of the new program directions and in workshop facilitation. Once we got to know the field test teachers well, and they had gained experience with the new program, we began to draw teachers with the same skills into the leadership role. In **Year Two** and **Year Three**, field validation teacher leaders and other identified educators provided leadership along with the Science Team. Science Team members were paired with field validation teacher leaders and/or post-secondary educators or scientists or field validation teachers worked together to provide leadership for the sessions dealing with teaching strategies.

Outside experts (post-secondary, business and industry, government, professionals) were brought in to provide background for teachers on various STS contexts. In **Year Two** and **Year Three** the Science Team played much more of a support role to the teacher leaders; the leadership had shifted significantly to teachers, particularly to the field validation teachers. This was an important element in the increase of acceptance of the new programs. The Science Team was very much aware that "teachers working with teachers" was the most effective way to promote implementation. We worked to maximize teacher leadership and the result was significant professional development gains for the teacher leaders and the session participants. The core of leaders identified and developed through the inservice session experiences became leaders for the new program across the province. Many of these teachers provided sessions in their own areas and for provincial teachers conferences and conventions.

- At first it was just us trying to dream up some schemes that would be good inservice and I think we had good ideas, but then it evolved to involve people we had involved previously and we networked outwards and we used the teachers in the planning and they became an important part of it.

- It was exciting when some teachers in the field test got quite excited about some aspects of the Science 10, 20 and 30 and they became salespersons, spokespersons for the program. They had an advantage over me because they had actually taught it and at that point I was still working at the Department and hadn't actually been in the classroom with it.

- As a team we certainly were on a learning curve as were the teachers and what really impressed me most was that the fact that the inservices began to build a lot momentum on their own. That tells a lot about the planning process and a lot about how we made more attempts to bring in folks who shared the Vision to help us deliver that particular Vision.

- Probably a highlight for me was the **Year Three** session with the chemistry-based activities—there was such a high energy level and interest in that session. People were practically bouncing off the walls and the room was just packed and so much excitement and so much input—people telling you "well, why don't you try this with this activity" or "I did this and it worked". It was almost the ideal session if I ever had one there—it just wasn't me telling. I had put out some activity stations (equipment, investigation instructions and suggested evaluation criteria) and people looked at it and were talking to each other about it and then were telling me about how it could be improved and telling each other about their experiences. It was great fun.

Curriculum/Evaluation Collaboration

- As someone out in the field now I really appreciate the diploma exams and how they reflect the spirit of the new courses, not only in Science 30 but Chemistry 30 as well—the open ended questions, the STS and so on. I get quite a bit of satisfaction out of seeing very conservative teachers now having to take this quite seriously—it makes quite a difference as to how you have to approach it—you really have to dig in and get into the program of studies and see what the framework is.

- It is interesting to me how there has been a shift. First the Curriculum Standards Branch folks were the ones out in the field, we were the ones meeting and talking with the teachers and now that has shifted to you folks in Student Evaluation. I'm hearing feedback from the field more through you now that the inservice and implementation phase is complete.

- I hope that we don't get satisfied with how far we have come. It is really vital now that Student Evaluation and Curriculum Standards keep working even more closely together. We have had such a turnover in Student Evaluation and the next step is to have a real advantage for kids who have done some good research work as opposed to a lot of knowledge type of stuff and also an activist type of approach where you go to the next step in STS, so we know what the problems are so what can citizens do about it. I hope we can keep going in that direction and not be satisfied with where we are.

School Level Collaboration

- Over the three-year course of inservice and implementation a major change with the staff at my school occurred. Prior to the first inservice these people had never talked to one another much—the biology, chemistry and physics teachers each did their own thing and there was little discussion or communication between the disciplines or even among teacher within a discipline—not a lot of collaboration going on. After the first year a little bit of it that happened as they started having common exams for Science 10 and made some attempt with to get together and work. By the time they got to the 30-level courses there was all kinds of discussion—somebody teaching Science 10 who didn't know much about physics would go to the physics teacher to ask "have you got any neat activities that would help me to teach this?" and the physics teacher with no biology background would approach the biology specialists and ask for suggestions on handling different topics. There was so much more collegiality—the group began to work together so much more by the end of the third year. That had never happened in all the years I had been there so it really changed the whole atmosphere of the Science Department.

Sense of Community

- It was wonderful to see the teachers and to listen to them on the teleconferences—to observe how they helped one another out, and how they offered information and how they were supportive of each another. In distance, they were all scattered across the province but it was like a huge extended family and with few exceptions they stuck together and they followed it through and it was terrific to watch. I thought of it as a community, the inservices as building a sense of community. At the end I felt a tremendous sense of loyalty toward the whole cause that had emerged with all the teachers and the Team.

A Story of Teacher Shift

- There was a very positive thing that happened this week. A staff member with whom I have worked for many years, a very conservative and traditional man, spoke out at a staff meeting and he probably gave the nicest compliment we all could have received. He taught Science 30 for the first time in his life and was shocked that he was going to have to teach it I guess. But having taught it and having taught some of the other parts of the new program he said at the meeting that this (the new science program) is one of the finest curricula probably on this continent—it is so flexible and so "right on". But here is a person who was dragged into this program "kicking and screaming all the way" and all of a sudden he is sitting in a meeting saying well it is what you make of it, it's a terrific program—I can't think of how you could have done it better—we are probably a model for half the provinces and half the states. And I thought, how marvelous, having just finished his first round of Science 30… it's amazing, it's just lovely to see.

Balancing Politics with Teacher Practice

The Science Team worked hard to balance the several shifts in political demand that occurred during the curriculum development phase with the reality of the classroom situation—striving to provide a program that had validity with teachers in the field. They often felt they had to compromise to political agendas that were struck without proper information going from upper level management to the decision makers. Upper level management themselves did not seem to have a clear "Vision of the Vision". Frustration with more attention being paid to political ends than to teaching practice is evident in the team's comments. The legacy of Alberta Education introducing new programs without providing adequate support for implementation continued to some degree with this project, although more resources than usual were allocated because of the high political profile this project had. The importance of proper support for education policy change is put forward in the team comments. Teachers journal comments reflected similar frustrations with political decisions they felt were detrimental to students in the long run and they did complain about lack of support for implementation, particularly in the **Year One**. Once they realized the degree of support they were receiving, comments were made that stressed the importance of the same support being provided for the rest of the teachers in the province—for those not involved in the field validation project.

- A major weakness of the entire educational system is that government often puts far reaching policies into place without the support mechanisms being there. Government has to find a way of getting ample support for the policy before they start implementing it. Most of the issues we had to deal with at the inservice were not related to inservice planning or the quality of programs—it had a lot to do with policy-based issues, people were against the changes because they didn't see why the policies were being put in place and where support for such policy was coming from.

- Going back to the early days when you were trying to get things going, you were making presentations as to what you were going to be doing *(for teacher inservice)*. I still have this fixation with a meeting at the APEGGA (Alberta Professional Engineers, Geologists and Geophysicists Association) offices where you made a wonderful presentation in the afternoon and I was totally preoccupied by the chaos that had gone on in the morning. So that to me was a wonderful juxtaposition—the down side of certain decisions being made for political reasons and your wonderfully forward thinking and positive attitude which I thought was the route we should be following and would have taken us a lot further along a lot more quickly rather than going back and reinventing the wheel as we were being forced to from the morning meetings.

- The frustrating aspect was always having to articulate what Science 20–30 was for, like who really needs it—and not just with teachers but I felt frustration that our leaders within the Curriculum Standards Branch were not very clear in their own mind as some would try and sell it as a panacea—take Science 10–20–30 and you don't need any of the disciplines which made no sense and we weren't really promoting that—so it wasn't easy for us to make a very clear description of who Science 20–30 could really be for so there was that uncertain ground that that program was on.

- We had one round of one-day callback sessions in **Year One** and then that was it (budget cuts caused us to discontinue in **Year Two** and **Three**)—that one day wasn't even enough. We had a very packed agenda—we broke people into groups and they had a chance to talk back and forth but we were just pushing them through to get as much feedback on the program of studies as we could—there wasn't enough time to meet their needs.

Exploring Future Possibilities

When the Science Team were asked about what they would wish for inservice support for the new program if there were no constraints on resources, they indicated, without exception, that the minimum provision should be inservice experience, such as we were able to provide the field validation teachers for every senior high science teacher in Alberta.

Inservice for All Teachers

- To change people you have to touch them very personally and I think the inservice we provided did that with many teachers, but it had little effect on the rest of the teachers that were not in the inservice. It just has to be on a much grander scale, there has to be some kind of intense workshops that involve every teacher that is going to have to deal with these changes. That of course is impractical so I really don't have any good suggestions for how to bring about change.
- It has to be a very personal thing, you have to touch teachers personally with some kind of intense workshop with many more people/to ensure that as a minimum our high school science teachers received the same kind of experience as the field validation teachers who attended the inservice/to provide the kind of inservice to all teachers that we did for the field test teachers so they would get into what the rationale and philosophy of the program.
- All the teachers in the province have the same experience that we and our field test teachers had because that would have cemented the program far better and I think it would have cost less in the long run.
- Inservice with all of the teachers instead of with the 100–150 teachers we did come in contact with over the three years. There was so much change in attitude toward the programs over the three years. So many of the teachers that I run into today in marking and item writing sessions now who did not have that inservice opportunity of the field test teachers don't understand the rationale for the change in the programs or the philosophy and they have such negative attitudes toward the Science 10–20–30. It really would have been nice to have them take part in the whole process as well.

Evergreen Policy

- Change is a slow process and in order to accomplish this effectively it would be ideal to have an evergreen policy where you have inservice on a continual basis and everyone is involved throughout the system—get away entirely from the "one-shot" idea of inservice.

School Administration Support

In their journal comments, some teachers mentioned the need for some administrative support to provide common spare periods for joint planning, to place more priority on the acquisition of improved technology. It was more in informal conversations with teachers that we discovered the degree of administrative support within the field test schools. When teachers had strong administrative support the implementation of the new programs was much smoother and more successful than in schools where administrative support was lacking.

- Support, particularly from the administration in the school and also with the resources, is important and that is something that we had an opportunity to do something about. But again, in bringing about change in administrators, how do you help them to understand and then to believe in the change?

Classroom Ready Materials

- We would have done better by putting more of our time and energy into developing classroom ready materials that teachers could have used that were in the spirit of the new program—in a sense the teachers then are learning from the concrete and then going to the abstract—the same way that students learn. So, if you had a number of these learning activities that are all laid out ready to use and teachers work through them with their class they begin to get a sense of what this is about and can appreciate the rationale, the philosophy, and the suggestions in the teacher resource manuals about alternate teaching strategies. We talked about it in general terms and then left it for teachers to do on their own. The kind of work that is being done right now on the video project would have been excellent to have at the time we were implementing and some of the resources that are available now, for the disciplines, support the sense of the program.

School Level Collaborative Planning

This comment seems to suggest that Alberta Education could provide additional support (funding and/or coordination) to schools to assure the teachers within each school have common time to do collaborative planning. In field test schools where this happened, strong support for the new program directions developed and implementation was greatly facilitated as the school science staff worked more as a team.

- Provision of time and resources for teachers within schools to be able to do the common planning—this occurred in a few schools where there was enough administrative support and some extra resources provided, but in a lot of situations it didn't occur. It would have been nice to help provide some of that time to make sure that all the teachers had a common spare so they could work on the planning together.

Increase Teacher Networking

- Enhance the networking among teachers—with e-mail now greater, possibilities exist. I think the phone network we had—the teleconference sessions—were good but they were just one particular time of the day, not always convenient to teachers, but the technology now could be really useful/perhaps even two years time there will be even more technology that would favour that type of communication.

Post Secondary Awareness and Acceptance

The following comments refer to the fact that solid post-secondary institution acceptance of the new Science 30 course as an important entrance requirement for routes other than science or engineering had not been successfully negotiated at the time of the field validation, nor during the first years of implementation. Creation of an important "niche" for the Science 30 course before provincial implementation of Science 10 would have assured the acceptance of the new Science 10–20–30 program as a suitable science route choice for students, parents and school counsellors. As it stands, millions of dollars have been spent on the development of an excellent program that has minimal acceptance by teachers, students, parents and administrators. Science 30 is now accepted more broadly in post-secondary institutions and is specified as a preferred prerequisite in a large technical institute. However, early political posturing between Alberta

Education and the University of Alberta and media coverage that resulted created a strong perception that the Science 10–20–30 route was "second class" or "watered down science". The Science Team felt that they had a responsibility for "selling" the program to the post-secondary institutions, a task in addition to their curriculum development and implementation responsibilities. They made an extensive effort to communicate the nature and advantages of this new program to post-secondary representatives. The power to make decisions on such acceptance matters lays entirely with the post-secondary institutions. The acceptance decisions made at Alberta's largest university were delayed and finally came too late in the implementation process to remedy the negative perceptions created by the initial refusal to accept the Science 20–30 science program as an entrance requirement subject. The question is—how could such an unfortunate situation be avoided in the future?

- Many stakeholders, particularly the post-secondary institutions did not and still don't have a clear "vision of the vision". If we didn't have that problem and they all had the same clear understanding of what was expected in the programs when the programs were implemented, we wouldn't have the problems that exist now (post-secondary acceptance of Science 30).

Here is one suggestion a team member made—a method to increase post-secondary awareness and commitment to a new program. I think it is a great idea!

- I would like to have seen representatives of post-secondary institutions becoming exposed to what was going on in those inservices. It would have been a revelation to a lot of them, the quality of work that was being done and the demands that were being made on the students. Reading curriculum documents is very dry but when you actually see the reality of what it means in a lab setting, then I think you take it seriously and it becomes very concrete for you. I think it would have been a wonderful educational opportunity if some of the more critical members of the post-secondary community had been exposed to what those teachers in the inservices were going through…it would have been a great marketing tool for the merits of the new program, and whilst I would concede it would be very difficult to involve those individuals, nonetheless while we are having this "best of all possible worlds conversation" I think it would have been a laudable activity.

Refresher Sessions

- It would have been useful to instead of having the inservice just in June to have something in January as well because you go through a semester of working on a course—in my case it was Science 10 in semester one and Science 20 in semester two—and at the end of semester it would be great to have some inservice, some rejuvenation before continuing on.

Chapter Summary

The story of a three-year teacher inservice project is now complete. The perspectives of the teachers involved, the project manager and the leadership team have been examined and all convey a sense of a dynamic and relatively successful, if challenging, process of learning. The inservice process was an interactive and important part of the larger process of development and implementation of the new centrally developed curriculum, resources and diploma examinations.

Chapter 6 presents a synthesis of what has been learned about inservice projects through the reflection and research involved in this study.

CHAPTER 6

WHAT HAS BEEN LEARNED?

> There can be no significant innovation in education that does not have at its center the attitudes of teachers, and it is an illusion to think otherwise. The beliefs, feelings and assumptions of teachers are the air of a learning environment; they determine the quality of life within it. (Postman and Weingartner, 1969, p. 33)

Study Summary

This case study is a critical examination of a three-year teacher inservice project associated with the implementation of a major curriculum change.

The three guiding questions for this study are:

1. What can be learned through critical reflection upon this three-year process of inservice planning, implementation and evaluation?
2. How do the theories related to constructivism, reflective practice and teachers' functional paradigms and theories of change provide a useful framework for the analysis and interpretation of this inservice process?
3. Using aspects of the theoretical framework and the findings of this study can a useful framework for teacher inservice planners be developed?

To address these questions a synthesis of the study findings and a planning framework useful to teacher inservice planners, particularly those charged with providing inservice activities for teachers implementing curriculum requiring significant change in teacher practice, are presented. A model for teacher inservice planning (Figure 6.3) is developed using teachers' functional paradigms as the theoretical construct with reflective practice being identified as the critical process within the model.

The aim of the inservice project presented in this study was to optimize teacher awareness, knowledge and understanding of a new centrally developed senior high school science curriculum by providing an environment in which commitment to the new program directions could develop. Inservice sessions were designed to provide opportunities for these teachers to develop and/or enhance classroom practice supportive of the new curriculum directions. This study extended and formalized the critical reflection done during the project itself into an examination of the completed project process from three perspectives; my perspective as project manager, the teachers' perspective as evident from an analysis of inservice journal comments, and the perspective of my Science Team colleagues as gathered from analysis of a group interview session. A synthesis and discussion of what was learned through critical reflection upon both the lived project process and the educational research associated with this study follows.

The Challenge of Curriculum Change

Alberta senior high school science teachers, most of whom were discipline science specialists, were challenged to move from a discipline based senior high school science curriculum (biology, chemistry and physics) to one providing an integrated science program stream (compulsory in the first year of high school) and new biology, chemistry and physics programs. All the new programs featured a strong science, technology and society (STS) component to provide motivating real-life contexts within which the knowledge, skill and attitude dimensions of the programs could develop. Although the use of STS contexts was a requirement, teachers had the freedom to choose from a wide variety of suggested contexts or to develop alternative contexts to best meet the needs of their students and their teaching situation.

> The goal of scientific literacy for all students, achieved through emphasis on the interactions among science, technology and society (STS) shaped the program of studies. (Alberta Education, 1991, p. S.1-3)

Teaching strategies and education theory are implicit in the curriculum documents and were made explicit in various student and teacher resources Alberta Education developed or identified for teachers and student use. The curriculum is implicitly constructivist in nature placing emphasis on the responsibility of the students for the construction of meaning and development of thinking and science problem-solving skills. Critical thinking skills, problem solving and decision making skills, are to be developed through active problem-solving activities. The themes of change, diversity, energy, equilibrium, matter and systems are presented as unifying concepts, "big ideas of science" that serve to link student learning across the various science disciplines. The curriculum statements that describe the desired characteristics of the learner in the knowledge, skill and attitude areas are directed toward the goal of developing scientifically literate and responsible citizens.

> To develop scientifically literate and responsible citizens, teaching must centre on students' development as thinking and caring members of society, rather than focusing on a body of knowledge isolated from its social context. It is crucial to society that scientific knowledge is used wisely, with due regard for the welfare of all members of society. (Alberta Education, 1991, p. S.1-5)

Creating the classroom environment to promote such construction of meaning and development of critical thinking skills is the challenge the teachers faced. In the new curriculum documents and resources the teacher role promoted is that of a facilitator of learning rather than that of an expert in science discipline knowledge. Ideally, teachers would use and model a process of reflective practice resulting in ongoing refinements of the STS contexts and various activities used with students to develop science knowledge and critical thinking skills. Teachers and students were called to become lifelong learners.

The following *Key Images for Teacher Preparation* were presented by Fullan (1993, pp. 115–116) as a framework whereby every teacher would become an agent of school and social improvement. These general objectives have great congruence with the directions of the new senior high science programs and the beliefs and intentions of the inservice leadership team as we began the teacher inservice project described in this study. The six points provide a good summary of important higher order goals for inservice planners.

1. Working with all students in an equitable, effective and caring manner by respecting diversity in relation to ethnicity, race, gender, and special needs of each learner.
2. Being active learners who continuously seek, assess, apply and communicate knowledge as reflective practitioners throughout their careers.
3. Developing and applying knowledge of curriculum, instruction, principles of learning, and evaluation needed to implement and monitor effective and evolving programs for all learners.
4. Initiating, valuing and practicing collaboration and partnerships with students, colleagues, parents, community, and social and business agencies.
5. Appreciating and practicing the principles, ethics and legal responsibilities of teaching as a profession.
6. Developing a personal philosophy of teaching which is informed by and contributes to the organizational, community, societal and global contexts of education.

Findings

Change in Teacher Practice: A Gradual Process

Teacher journals in the first year of inservice reflected considerable skepticism and anxiety. As the process of inservice continued over the three years, and as teachers worked with their colleagues to implement the new curriculum in their classrooms, teacher confidence increased as they gained classroom experience with the new curriculum and their input helped shape the developing curriculum specifics and the resources. Major and positive changes in attitude and practice were seen in most teachers over time. The teachers' journals, my Science Team colleagues' comments, and my own observations indicated that individual teachers' change in classroom practice is much more **evolutionary than revolutionary**. There was a gradual increase in acceptance and momentum to implement.

Comments teachers made in their initial inservice journals indicated great diversity in their current paradigms and their readiness to consider the paradigm presented by the new curriculum. Judging from the journal comments and my contact with the field validation teachers, about 10% of them were already strong supporters and practitioners of most of the general directions the new curriculum was taking. These teachers, once identified, became a strong pool of leadership for the project. Another 10% of the teachers were vehemently opposed to the new directions for a variety of reasons and resisted efforts to cause them to critically examine their beliefs and feelings. Little or no change in practice occurred with most of this group over the duration of the project. However, there were a few very vocal opponents that eventually did come to support and implement the new curriculum demonstrating dramatic shifts in attitude. The other 80% of teachers were undecided about the new directions and were reserving judgement—they were skeptical and had a "wait and see' attitude. Shifts that occurred in their paradigms were gradual as teachers took ideas they believed had promise and tried them out in their classrooms. Gradually, commitment developed through ongoing cycles of critical reflection and action.

The projects' inservice activities were planned to encourage teachers to identify, examine and reformulate their science teaching paradigms and to really grow professionally. The total project including the inservice activities promoted and supported shifts in leadership and ownership of the project to the teachers. Provision of an environment to promote teachers working with other teachers at the inservices as well as encouragement and support for school level teacher teams to collaborate in their practice was the project goal. Teachers who were actively reflecting on their experiences with the new curriculum through interaction with their colleagues tended to have a greater degree of comfort and confidence than those working individually. However, both groups gradually moved to greater confidence and competence as the project progressed. A credible curriculum coupled with appropriate professional development activities led to gradual acceptance and classroom level action to implement the new curriculum directions.

The three-year duration of the project and the long-term togetherness of the group, was an advantage in developing these shifts. The continuity allowed for great collegiality to develop among the teachers; a real sense of working as a member of a large group of mutually supportive professionals began to emerge. Trust and rapport developed between the teachers themselves and the teachers and the Science Team leaders, and that increased the possibility of critical reflection as ideas, opinions and experiences were shared more freely.

Inservice: A Catalyst for Change

Inservice, although an important factor, was only one event with potential to significantly affect teachers' functional paradigms serving to introduce, initiate and catalyze the changes in teaching practice. Another key factor was the extensive interaction with teaching colleagues that not only the inservice sessions but the total project provided. As most teachers were discipline experts and were challenged to implement an integrated science course in **Year One**, field test school science teaching staffs were drawn together by the need to help one another; to learn from each other and provide mutual support. The many resources associated with the new curriculum—the teacher resource manuals, teacher guides and student texts all provided strong models that could work well in the classroom once teachers tried them. Use of such resources could be the beginning of the development of confidence in the new program directions. I can remember encouraging teachers who were considering a particular strategy for the first time to talk to another teacher who had been successful with that strategy. My experience and that of my Science Team colleagues was that teachers talking directly with other teachers proved a powerful factor in their journey toward change in classroom practice. Administrators who were program supporters could significantly influence teachers in their schools to really examine the new program through school level encouragement and provision of professional development time. Professional development sessions that related to the new curriculum at teacher conventions and conferences could also work with the project inservice session to encourage the desired changes in teaching practice.

Teacher Functional Paradigms: A Key Consideration

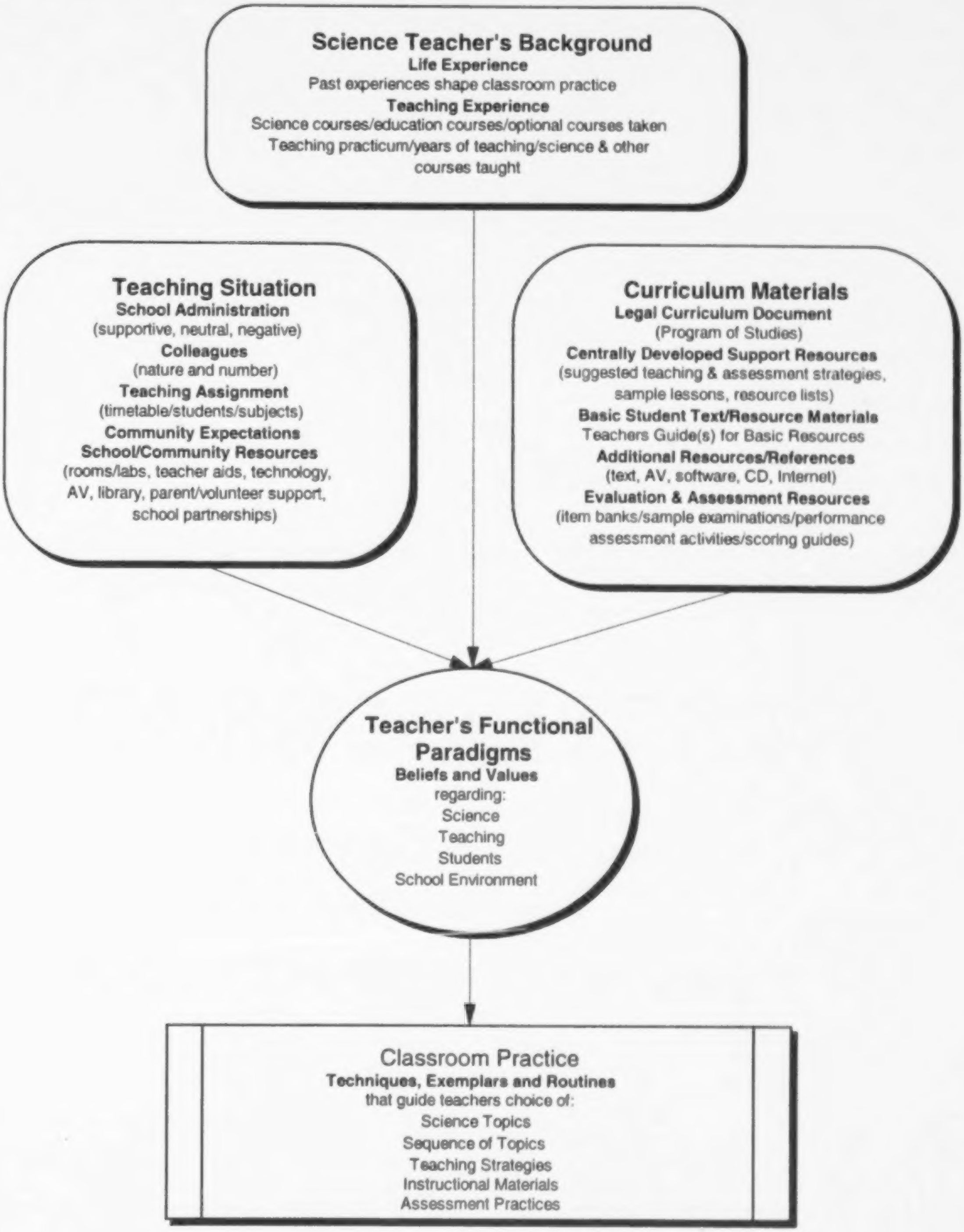
The planning process for teacher inservice to support such major changes in teacher practice must take into account the teachers' functional paradigms and the important role of reflective practice.

> Functional Paradigm: The constellation of beliefs, values, techniques, exemplars, and routines shared by a group of teachers and used by them to guide their classroom practice. (Lantz & Kass, 1987)

These considerations go far beyond the many important tangible and more technical issues associated with implementation of a new curriculum. It is often the timely development of curriculum documents or teacher and student resources and the provision of opportunities for teachers to develop expertise in appropriate teaching and assessment strategies that become the primary focus for curriculum developers, inservice planners and the teachers involved in such changes. Time pressure and shortage of resources in the implementation phase is common in many large centrally developed curriculum change projects, such as the one discussed here. Political expediency often serves to focus the energy and resources available on the more easily defined, tangible and technical parts of the curriculum implementation. One can point to excellent programs of study, to text and video resources, to teachers guides and manuals, to inservice session schedules and examination item banks but teachers' beliefs, feelings and attitudes about the new curriculum cannot be so easily demonstrated. It is these very attitudes, feelings and beliefs that are critical to successful implementation.

Figure 6.1 presents a model that indicates important influences on a science teacher's functional paradigm and the relationship of the paradigm to classroom practice. It is a modification of a model of teacher interpretation of curriculum materials developed by Lantz and Kass (1987).

Figure 6.1: Science Teacher's Functional Paradigm and Classroom Practice


Science Teacher's Background
Life Experience
Past experiences shape classroom practice
Teaching Experience
Science courses/education courses/optional courses taken
Teaching practicum/years of teaching/science & other courses taught
Teaching Situation
School Administration
(supportive, neutral, negative)
Colleagues
(nature and number)
Teaching Assignment
(timetable/students/subjects)
Community Expectations
School/Community Resources
(rooms/labs, teacher aids, technology, AV, library, parent/volunteer support, school partnerships)
Curriculum Materials
Legal Curriculum Document
(Program of Studies)
Centrally Developed Support Resources
(suggested teaching & assessment strategies, sample lessons, resource lists)
Basic Student Text/Resource Materials
Teachers Guide(s) for Basic Resources
Additional Resources/References
(text, AV, software, CD, Internet)
Evaluation & Assessment Resources
(item banks/sample examinations/performance assessment activities/scoring guides)
Teacher's Functional Paradigms
Beliefs and Values
regarding:
Science
Teaching
Students
School Environment
Classroom Practice
Techniques, Exemplars and Routines
that guide teachers choice of:
Science Topics
Sequence of Topics
Teaching Strategies
Instructional Materials
Assessment Practices

The Prevailing Paradigm: The Desired Shift

Most Alberta senior high school science teachers had teaching background preparation and experience that focused on acquisition of science discipline knowledge. A "teacher as expert" model was what most teachers had experienced and it was the model most likely used in their classrooms. A lecture presentation with students taking notes combined with formal science laboratory sessions was pretty standard classroom practice.

> Conventional wisdom holds that teachers, in fact, are little influenced by teacher education, and are more likely to teach as they themselves were taught. (Crocker, 1983, pp. 358–359)

The Alberta science teachers' collective functional paradigm as the inservice and implementation project began was characterized by the needs assessment and field validation teachers' journal comments in **Year One**:

- genuine concern for the good of the student
- teacher viewed as having the primary responsibility for student learning
- science discipline knowledge and expertise valued (teacher as expert)
- clear and specific curriculum documents and student outcomes valued
- comprehensive student and teacher resources viewed as essential
- comfort with direct instruction techniques
- priority placed upon effective classroom management
- major focus on student results on formal examinations, particularly the diploma examinations—student performance strongly linked to future success of student (post-secondary entrance requirements) and teacher's professional reputation.

Table 6.1 shows two ends of the spectrum of teacher practice. In reality, teacher practice falls somewhere between the two. As the new curriculum implementation began, the prevailing tendency in the Alberta science teachers' practice fell considerably more to the "teacher as expert" or transmission model of teaching than the "teacher as facilitiator" of learning or transactional end of the spectrum. The new senior high science curriculum in Alberta called for a considerable shift from the "transmission model" of teaching to the "transactional model" of learning. This table is a modification of a similar table developed by Monson & Pahl (1991) that dealt with the shifts associated with a new course with whole language.

Table 6.1: Shift in Teaching Paradigm - Desired Directions for a New Science Curriculum

Transmission Model **Teacher as Expert**	→	**Transaction Model** **Teacher as Facilitator**
Defining What We Know	*Objective*	Interacting with the Unknown
Science Discipline Knowledge	*View of Science Presented*	Interdisciplinary Science, Science as Inquiry, Problem-Solving
Acquisition of Knowledge	*Purpose*	Improved Critical Thinking Skills

Teacher Centred Instruction	→	**Student Centred Learning**
Part to Whole	*Strategy*	Whole to Part
Skills Based	*Content*	Concept Based
One Dimensional	*Context*	Multi-dimensional
Dissemination of Information	*Teacher Role*	Catalyst for Problem-Solving
Passive Learning	*Learner Role*	Active Learning
Mastery	*Assessment*	Demonstrated Competence

Valuing Current Teacher Practice

During inservice sessions the value of direct instruction techniques and discipline expertise was not discounted. Teachers were encouraged to evaluate their present practice on a continuum and identify where they were in relation to the various strategies being explored at the inservice sessions. Appendix F provides some of the materials used with teachers in the **Year One** plenary session. Included is an example of an overhead transparency used with teachers that indicated a self-rating of my classroom practice in relation to several of the more important directions being presented by the new curriculum and being explicitly dealt within the **Year One** inservice. The model presented was to encourage teachers to identify and build upon their present strengths in teacher practice and to gradually gain confidence and expertise in teacher practices that lay more toward the transactional end of the model in Figure 6.2. An evolutionary rather than revolutionary change was discussed with value and respect given current teacher practice, the foundation upon which future practice was to be built. Teachers were encouraged to take their time and gradually integrate new strategies as they became comfortable with them and with the new curriculum. In the inservice sessions it was acknowledged that the implementation of the new curriculum would involve teachers selecting from the broad range of suggested strategies the one(s) that given their particular teaching style and situation seemed to fit—they would be implementing changes they felt appropriate in their own manner and at their own rate.

How Does Meaningful Change in Teacher Practice Occur?

Teacher practical knowledge has a major influence on teachers' attitudes, beliefs and feelings about science teaching. These beliefs, feelings and attitudes, their functional paradigms, are a pivotal factor that an inservice planner must take into consideration when faced with the planning of effective inservice activities.

An important element of teacher practical knowledge is the vision or mental picture teachers hold of how the teaching situation should be. It provides the framework from which teachers can make adjustments that bring together the rules and principles of practice and the teacher's beliefs and values, with the demands of the current situation. Most decisions for action reflect this vision. When actions are not well aligned with the vision, painful dilemmas confront the teacher. The greater the misalignment, the more painful the dilemma becomes. Implementation of new curriculum provides such a dilemma for teachers; the degree of the dilemma is determined by the degree of incoherence between the teachers current vision and the vision being presented by the new curriculum.

Leaders Learn: Teacher Practical Knowledge and Early Paradigm Shifts

As the new Senior High Science curriculum evolved key Alberta Education officials, the Alberta Education curriculum development team members and the many educators involved in the various development committees had to identify and critically examine their own functional paradigms of science teaching; to carefully consider what science teaching meant to them and what they believed would be best for the student. The directions of the Senior High Science Program Vision (Appendix G), philosophy, rationale and the program content were shaped by a number of factors: consideration of recent research in the science education area, the results of provincial needs assessment and the political directions established for the program. A major influence came from the personal functional paradigms, the current and evolving beliefs and feelings regarding science teaching, held by the members of the Science Team, the lead developers of the new curriculum. The functional paradigms of these educators evolved to encompass belief and commitment in a major broadening of the conception of the teaching of science. They became committed to the development and implementation of a curriculum that provided for both an integrated science and/or discipline science routes. All the new programs promoted the development of thinking skills through the use of a thematic framework, strong STS contexts, a high activity/skills focus and the integration of strategies, such as technology use, cooperative learning, library and laboratory research activities, peer assessment and performance assessment. This rethinking involved consideration of the role of the science teacher, shifting away from the "teacher as expert" model toward the "teacher as facilitator" of learning model described previously.

In developing and implementing inservice activities for the field validation teachers involved in this project, I drew strongly upon my teacher practical knowledge and that of my Science Team colleagues. The fact that we all were relatively recently high school science classroom teachers proved a great advantage in the inservice planning process. We brought our personal teacher practical knowledge to the consideration of the important issues of how the new curriculum related to the Alberta teachers' past experiences, to their current teaching situation and to their vision of how the teaching situation should be—three important components of teacher practical knowledge. Because each of us had gone through the process of examining our own beliefs regarding science teaching during the curriculum development phase we realized that each teacher involved in the implementation would have to go through a similar process. This process required teachers to have a clear understanding of the new program directions coupled with the time and opportunity to examine question and explore all facets of these directions relative to their current classroom practice. The new curriculum vision, rationale and philosophy would have to be understood and believed to be better for students before effective action to implement the new directions would occur at the classroom level. The whole first round of inservice sessions were planned with that purpose—to provide the what, the why and the how of the changes to the teachers in an environment that allowed for critical reflection upon their basic beliefs about science teaching.

During the project, we also found it useful to ask of ourselves the very practical question "What would I need to assist me if I were implementing this new science curriculum?". At the beginning of the project, the needs assessments and the collective teacher practical knowledge of the Science Team helped provide insight into these important questions. As the project progressed the many modes of communication with the field test teachers, particularly the teacher inservice journals, provided further insight that informed the inservice planning process.

Nurturing Shifts in Field Validation Teachers' Paradigms

Looking back upon the Alberta senior high science curriculum project and this research study I am once again struck by the magnitude of change this implementation implied for teachers. The new Senior High Science curriculum called for a considerable shift in the prevailing teacher practice—a shift in the collective functional paradigm of senior of high science teachers and consequently shifts of varying degrees in the paradigms of individual teachers. Such curriculum change provides educators with a golden opportunity for professional development; a focus event that invites them to reevaluate and refine their teaching functional paradigm.

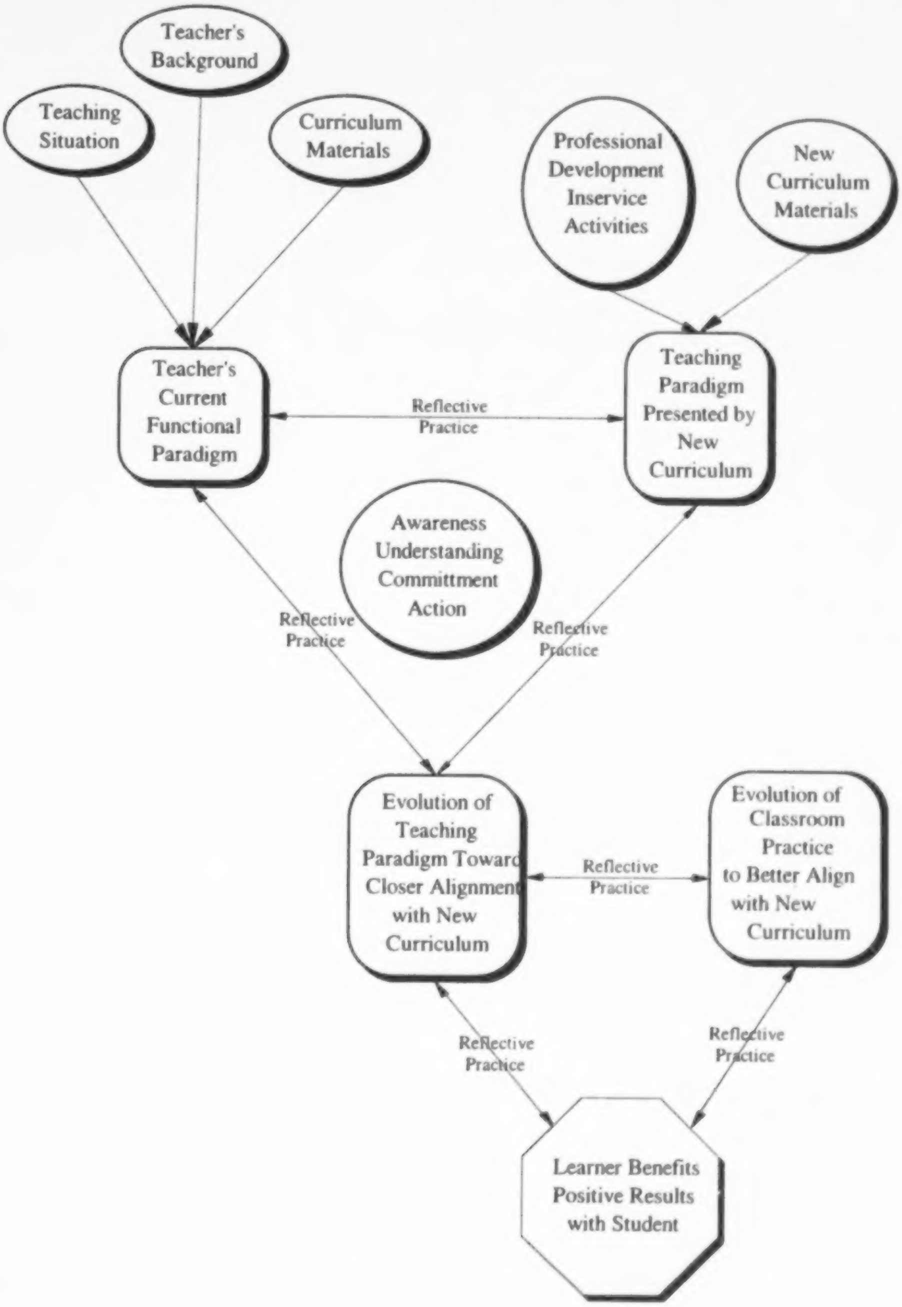
> Most of the problems associated with implementing a constructivist approach to teaching could be overcome if teachers were willing to rethink not only what it means to know subject matter, but also what it takes to foster this sort of understanding in students. This is a tall order. Such change is unlikely to occur without a good deal of discussion and reflection on the part of teachers. Identifying what is problematic about existing beliefs, however, is an important first step in the change process. (Prawat, 1992)

As the implementation of the new senior high science curriculum began, each senior high science teacher in Alberta had their own conception of what teaching senior high science programs involved. These teachers as individuals represented a broad spectrum of science teaching practice, some more closely aligned with the new curriculum directions than others. If a major curriculum change is to result in meaningful change in teacher classroom practice it must engage teachers at a very personal level. Teachers must be encouraged to wrestle with their beliefs and values as related to the teaching of science. They are called to carefully reexamine, to critically reflect upon what they believe good science education is.

Ideally, inservice activities provide the opportunity and environment for teachers to critically reflect upon their current paradigm of science teaching and to compare it to the paradigm that the new curriculum is posing. They should be prompted in such activities to address a fundamental question: "Would the proposed curriculum be better for my students?" If after careful consideration the answer is: "these new directions would provide a better education for my students" then the next question can be: "how can I move toward implementing these changes in my classroom?". Interactive sessions where educators can dialogue with colleagues provide an ideal environment for consideration of the changes; for comparing the previous curriculum with the new one and weighing the benefits and the drawbacks. An educator can be prompted by inservice activity or some other significant event to consider the possibility of realigning their professional functional paradigm in areas where there is a lack of congruence with the new curriculum. If such critical reflection does not occur, commitment to the new curriculum vision will not develop and action to implement the new directions in the classroom will not be optimal.

The model presented in Figure 6.2 attempts to capture major elements of the complex process critical to meaningful change in classroom practice during times of major curriculum change. The diagram does not capture the diversity of experiences that can trigger or support reflective practice nor the individual variability in the rate and extent of personal paradigm shift. It focuses on the inservice activity component and the role it can play in teacher change.

Figure 6.2: Teacher Functional Paradigm Change: An Inservice Process Model

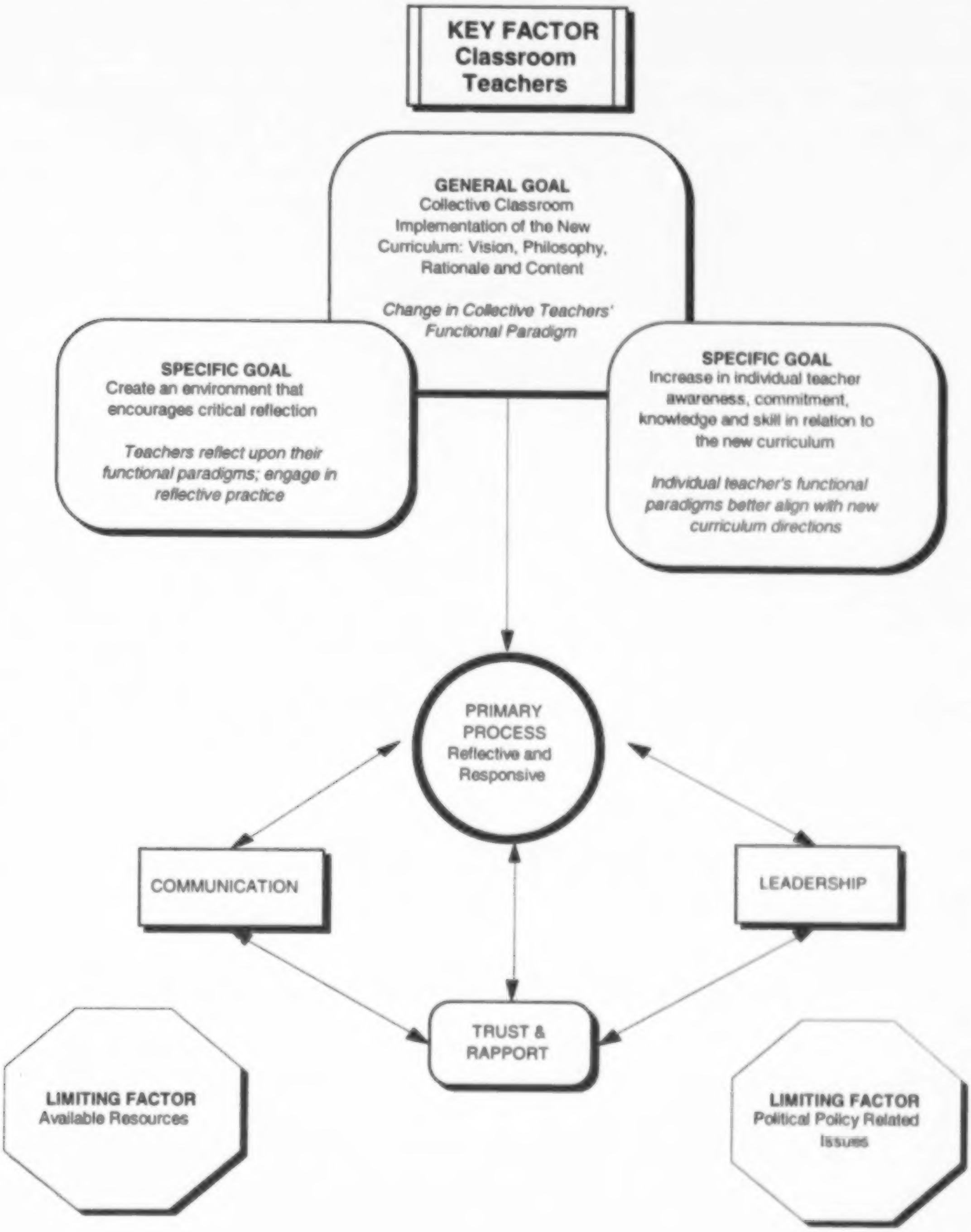

Teacher's Background
Teaching Situation
Curriculum Materials
Professional Development Inservice Activities
New Curriculum Materials
Teacher's Current Functional Paradigm
Reflective Practice
Teaching Paradigm Presented by New Curriculum
Awareness Understanding Committment Action
Reflective Practice
Reflective Practice
Evolution of Teaching Paradigm Toward Closer Alignment with New Curriculum
Reflective Practice
Evolution of Classroom Practice to Better Align with New Curriculum
Reflective Practice
Reflective Practice
Learner Benefits Positive Results with Student

Reflective and Responsive Process: Leadership, Communication, Trust and Rapport

How do inservice planners create an environment that encourages teachers to critically reflect upon their functional paradigms—to become reflective professionals who develop awareness, commitment, knowledge and skill in relation to a new curriculum? A dynamic reflective and responsive process proved successful during the inservice and implementation project described in this study. The creation of such an environment was closely linked to the project leadership, project communication and the degree of trust and rapport developed between the leaders and the teachers and among the teachers themselves. Communication, leadership and the development of trust and rapport were the three major interactive factors that were integral and critical parts of the reflective and responsive process employed. As in any project the potential for responsive action to issues raised during the process was limited by the resources allocated and the prevailing political policy.

Figure 6.3 provides a framework for summary discussion and identification of the key factors associated with inservice planning and implementation. This summation is presented in four sections addressing process, leadership, communication and development of trust and rapport. The discussion and the key points provide a summary of the specific findings of this research study, pulling together important learnings from reflection upon the analysis of the teacher journal comments, the leadership team interview comments and my perceptions as project manager.

Figure 6.3: A Model for Teacher Inservice Planning and Implementation


KEY FACTOR
Classroom Teachers
GENERAL GOAL
Collective Classroom Implementation of the New Curriculum: Vision, Philosophy, Rationale and Content
Change in Collective Teachers' Functional Paradigm
SPECIFIC GOAL
Create an environment that encourages critical reflection
Teachers reflect upon their functional paradigms; engage in reflective practice
SPECIFIC GOAL
Increase in individual teacher awareness, commitment, knowledge and skill in relation to the new curriculum
Individual teacher's functional paradigms better align with new curriculum directions
PRIMARY PROCESS
Reflective and Responsive
COMMUNICATION
LEADERSHIP
TRUST & RAPPORT
LIMITING FACTOR
Available Resources
LIMITING FACTOR
Political Policy Related Issues

Reflective and Responsive Process

The Science Team, comfortable with the reflective and responsive process that had been used throughout the curriculum development project, quite naturally continued use of this process in the inservice planning and implementation phase. This process was very much a "learn as we go along" experience for both the leadership team and the teachers involved. Just as the teachers had never taught the new curriculum before, the team had never been involved in the planning and implementation of such a massive inservice program. We shared this dynamic learning environment with the project teachers. The teacher inservice project was a collaborative and positive professional development experience for both the inservice leadership team and the teachers.

As project manager, I used a collaborative team approach to inservice planning. Initial needs assessment data and the collective teacher practical knowledge of the team informed the development of a initial, but ever evolving inservice plan. It proved effective to bring draft inservice plans incorporating all the information I had access to the whole team for discussion, revision and completion. As the team was extremely busy on many other facets of the new curriculum development project a specific starting point for discussion was appreciated. In putting those initial draft plans together consultation beyond the team was common—consultation with project school administrators and representatives of post-secondary institutions, government and business and industry.

The science, technology and society contexts of the new curriculum called for leadership well beyond the education sector. An initial and ongoing involvement of post-secondary institutions as partners in planning and implementation proved very beneficial. This partnership built curriculum awareness and goodwill with representatives of the faculties of education and/or science at the three major universities in Alberta. Faculty members collaborated to provide leadership expertise for various inservice sessions and university facilities were provided at a very reasonable rates.

The leadership team would gather information, observe, listen and learn from the teachers involved in the project not only during the inservice activity periods but throughout the whole three year field validation project. Various forms of formal and informal communication provided solid information from the project teachers to the team. As inservice project manager I worked with the Science Team to carefully consider teacher input and made genuine efforts to address the needs and concerns of the project teachers in the inservice activities—within the bounds of resources and political policy. Reflection upon what teachers were communicating informed all facets of the project and provided the information needed for responsive action in all areas.

Key Points

- Inservice activity ideally is a collaborative and positive professional development experience for the leaders and the teachers.
- A broadly consultative needs assessment and planning process increases the quality of the inservice experience (team colleagues/teachers/educational administrators/university educators/teachers' professional organizations).
- A dynamic cycle of consultation, planning, action, evaluation and reworking the plans work well.

- Post-secondary institutions can become excellent partners for planning and implementing teacher inservice.
- Providing well researched initial draft inservice plans as a starting point for the reflective and responsive team planning proved effective.

Leadership

Inservice project leadership was provided by a project manager and a team of classroom educators who were strongly grounded in classroom practice and had credibility with their colleagues in the field. This group of educators played lead or supporting roles in the new curriculum development, resource development and identification, evaluation instrument development, and the inservice planning and implementation. Each Science Team member had a comprehensive picture of the whole project and had developed great commitment to the new program directions through participation in all facets of the project.

Leadership at the inservice sessions in **Year One** was provided by both the Science Team members and high school and post-secondary educators with expertise and strong facilitating skills in relation to strategies supportive of the new curriculum directions. In **Year Two** and **Year Three** the Science Team's leadership in inservice sessions lessened as project teachers, who emerged as strong advocates and classroom practitioners of the new curriculum directions, were invited to present sessions. Whenever possible, a Science Team member was paired with a project teacher to create a leadership team. When project teachers provided inservice session leadership, teacher teams were struck to provide two classroom perspectives on the particular strategy and an opportunity for collaborative planning and presentation. In **Year Three**, leadership teams providing workshops on sample hands-on activities included a post-secondary science specialist partnered with a team representative. The process of broadening the base to include classroom teachers and other credible education stakeholders built awareness, support and ownership for the new curriculum. Resistance was reduced and acceptance built by assuring that core sessions on teaching strategies were grounded in classroom practice. Leadership sharing was an important factor in the development of a sense of common purpose; in the building of rapport, trust and collegiality between the team leaders and the project teachers.

Key Points

- Central leadership is provided by a team of classroom educators—grounded in classroom practice with credibility in the field.
- Leadership team is involved in the whole curriculum development and implementation process (curriculum, resources, evaluation and inservice)—knowledgeable of, and committed to the new curriculum directions.
- "Teachers working with teachers" is more effective than central leadership–maximize teacher leadership in inservice activities.
- Leadership on teaching strategies is initially shared and then shifted into classroom teachers, post-secondary educators.
- Leadership is shifted to project teachers as soon as leaders emerge—seek out and nurture these leaders throughout the duration of the project (builds trust and rapport, collegiality, a sense of common purpose that leads to greater new curriculum acceptance).

- Teacher involvement is maximized in the development of teacher resources (teacher guides, workshop modules, test items, sample examinations, videos).

Communication

Every aspect of inservice and implementation planning and implementation depends on effective communication. Open, ongoing and effective communication was critical to the reflective and responsive process used. Teacher reaction to all project elements was needed to allow responsive action to be considered and taken. Communication plans had to provide for extensive communication between the members of the leadership team, the team leaders and the teachers, teachers within each school, teachers from the various project schools and the team, and numerous other groups and individuals affected by the curriculum change (administrators, school counsellors, parents, post-secondary partners). The quality of the leadership and the development of the trust and rapport within the project is directly related to the quality of communication process.

Communicating Needs

Before inservice planning began, extensive communication with teachers and administrators was undertaken to determine what they felt they would need to implement the new curriculum. The Science Team presented the new curriculum Vision and draft programs to groups of teachers and administrators, engaging them in discussion about the new curriculum directions and their implementation needs. This mode of interaction increased program awareness in the field and communicated the leadership teams' willingness to consider the voice of teachers in the program development and in the inservice and implementation planning process. This information to plan the initial inservice activities and the development of the various print resources.

Teacher Journals: Key Communication Tool

In the initial planning for the **Year One** inservice a method of communication that would provide a snapshot of the project teachers' beliefs, feelings and ideas regarding the curriculum change, the field validation process and more specifically their reaction to the inservice activities was needed. A streamlined and abbreviated "teacher journal' format was selected and teachers completed a section of this journal after each inservice session they attended. The teacher journals worked extremely well, providing valuable insight into the teachers' perspective on the whole project, but particularly on the various inservice sessions presented. The teacher journals became a major communication tool for the whole project. The team was able to discuss and reflect upon this information and initiate responsive action where appropriate and possible. Such responsive action assured the teachers felt that they were heard and it built rapport and trust within the project. When action on relatively major concerns was impossible the reasons were clearly communicated to all teachers in plenary sessions, newsletters, teleconferences and through individual conversation. The inservice planning was responsive to expressed teacher needs as far as the limiting factors of available resources and the political policy would allow.

Teacher journals indicated that at the **Year One** teacher inservice they had many questions that had to be answered clearly and honestly to reduce the anxiety associated with "not knowing". Communication strategies for the project had to assure that all these questions were adequately answered and that all of the various print resources to support classroom implementation were available on time to all project teachers. The initial needs assessment and the practical classroom knowledge of the Science Team informed the planning of various methods to effectively communicate with teachers on all these questions. Curriculum documents, resources and inservice sessions were all planned and developed to communicate with consistent and clear messages. In several cases, the authors of sections in the teacher resource manuals were also the leaders identified to present inservice sessions on the topic they developed in the manuals.

The key questions that emerged in the **Year One** journals as requiring immediate answers through direct communication in the inservice sessions and in the print resources were typical of the major questions teachers involved in any field validation of new curriculum would ask. These questions arranged under topic headings were:

Key Questions

New Curriculum Vision (philosophy and rationale)
Why was the program changed? What are the new program directions? How will the new program be better for my students? How does the new program compare to the previous program?

Program Specifics
What is the depth and scope of the new program?

Roles and Responsibilities
What are the roles and responsibilities of project teachers and the central agency?

Resources
What student and teacher resources will be used in the field validation project?
What form will they be in? When will we receive them?

Assessment and Evaluation
How are students to be assessed and evaluated? What is the evaluation framework?
What will be the impact of the new programs on the diploma examinations (standardized provincial graduation level examinations)?
Will sample assessment items and unit and final examinations be available?

Teaching Strategies/Teacher Background
What teaching strategies are appropriate for the new program?
Are the strategies I currently use appropriate for the new programs?
Will we receive practical background and materials to support the implementation of appropriate strategies?
How does the teacher prepare to teach an interdisciplinary course when she/he has specific science discipline(s) education and experience?

Communicating the Desired Model—Leaders as Facilitators

All inservice workshop and session facilitators were selected based upon their expertise and their communication skills. Ability to encourage and lead dialogue and discussion in their topic area was important. Ideally leaders were facilitators, modeling the type of active learning environment we hoped the project teachers would create in their classrooms as they implemented the new curriculum.

Communication for Confidence Building

If trust and rapport is to build in an inservice project, the reflective and responsive process of the leadership team requires multiple mechanisms of formal and informal communication with teachers. Confidence in leadership will develop if the team can be responsive to needs freely communicated by the teachers. Teacher confidence with the new program directions builds if communications provide them with the needed information and support. All communication must be framed in a manner that is respectful of teachers' practical knowledge and their classroom reality.

The many print materials that are required by teachers implementing new curriculum play a major role in communicating new curriculum directions and encouraging shifts in practice to complement those directions. All these materials, including draft curriculum documents, teacher manuals to support the new curriculum directions, draft student and teacher resources in development, basic student and teacher resources identified, and inservice session hand-out materials, must provide clear and consistent messages, examples and information that support the new curriculum directions. Most of these documents were in draft format and the teachers were asked to communicate their thoughts about the developing curriculum and the various resources. The leadership team would then reflect on their feedback and make revisions as appropriate and possible. Teachers place great value on having good print resources and they are a lasting form of communication that can be a powerful tool to support classroom implementation. They also value the professional opportunity to provide their input and to have it seriously considered during the development phase.

Formal mechanisms for communicating with teachers regarding their response to the new curriculum, resources and inservice sessions included teacher journals, teleconferences and formal written response forms. Informal communication that allowed receiving of feedback on all aspects of the project and for provision of collegial advice and support included letter exchange, fax message exchange and telephone conversation. In **Year One** several day long school visits, including classroom visits by leadership team members, resulted in valuable communications with teachers and students that informed the inservice planning process as well as all aspects of the project. Also in **Year One**, a project newsletter was used as a means of communicating with teachers and it was well received. Both the school visits and the newsletter were discontinued in **Year Two** and **Year Three** due to fiscal restraint within government.

Communication between implementing teachers within each school and between teachers at the different schools was encouraged in the planning of the inservice sessions through purposeful assignment of teachers to inservice activity groups and encouragement of a team approach in implementation. Much more effort could have been made if time and resources had allowed. Such interaction between teachers is extremely important as they can support one another and collaborate to enrich the implementation experience for themselves and their colleagues.

The leadership team made consistent efforts to encourage teachers to contact them whenever teachers had a question, concern or suggestion. A tremendous amount of both formal and informal communication occurred between teachers themselves and between teachers and the leadership team at the three major inservice sessions. All inservice events were designed to encourage such interactions, even the social functions.

A Communication Challenge: Sustaining Curriculum Change Efforts

Once teachers believe a new curriculum change is better that the preceding curriculum for their students they act to implement it in their classrooms and become major ambassadors for the program. They communicate positive messages about the curriculum to their students, school administrators, school counsellors, and within their school and home communities. The inservice activities of this project played an important part in the development of these "teacher ambassadors" and "new curriculum leaders" to get the momentum toward implementation going. However, the whole process of implementation is facilitated if teachers have support coming from within their schools and communities. Implementing new curriculum is very hard work; change is stressful and teachers need support to nurture their enthusiasm and commitment to new program directions. Students, school administrators, guidance counsellors, parents, post-secondary institutions, professional organizations and a wide variety of education stakeholders in the public sector can be strong advocates and provide various kinds of support to the implementing teachers.

If a major curriculum change is to be facilitated and sustained all those affected by the changes must be involved in learning and come to understand what the changes are, why the changes are being made and believe that such changes are an improvement for students. All stakeholders ideally become involved in a learning process similar to what the implementing teachers must go through albeit to a lesser degree. Such understanding and support development begins with the curriculum development team and the teachers involved in program development committees, moves to include the field validation teachers, and then to all implementing teachers and to all education stakeholders. Effective communication of the intent, the Vision for a new curriculum, is critical to gaining such support.

The post-secondary institutions are critical stakeholders in implementation of senior high school level core courses and need to be given serious consideration from the on-set of the project. For high school core programs, post-secondary institution entrance acceptance for new graduation level courses into well respected programs is particularly important. It was this post-secondary support and acceptance for the new integrated Science 20–30 program that was problematic in this project. The initial University of Alberta refusal to accept Science 30 and the publicity surrounding that initial rejection, even though after redrafting the course was recognized, did great damage to the public image of the Science 20–30 course sequence. The effect of the delay in recognition of Science 30 by the University of Alberta has been detrimental to general provincial implementation with enrollment figures in this new stream being less than 10 percent of those hoped for by Alberta Education. The Science 10–20–30 course sequence had been designed to serve the majority of senior high science students—all those who would not be pursuing careers in areas directly related to science or engineering. Early and ongoing communication at high political levels between the University of Alberta and Alberta Education could have prepared for a wider acceptance than appears to be the case at this time.

It was unfortunate that the resources available within this project did not provide for sufficient time or effort being paid to the development of program understanding and support with school principals and school counsellors. The Science Team, as indicated in their interview comments, were aware of the importance of developing firm support in these areas and made as much effort as the project resources allowed. The efforts made involved mailing out information to schools and this did not prove particularly effective.

Key Points

- Gather and carefully consider the beliefs, feelings and ideas of teachers regarding the curriculum change, the field validation process and the inservice activities to inform planning.
- Teacher participant journals are an excellent inservice evaluation and trust building tool, promoting teacher reflection on the new program.
- Multiple mechanisms for open and ongoing formal and informal communication are desirable.
- Initially, teachers have many questions that have to be addressed—anticipate them through needs assessment and discussions with a variety of stakeholders, especially the leadership team.
- Inservice leaders are facilitators of learning and communicate the model of teaching practice appropriate for the new curriculum directions (planned strategy).
- Communication is framed in a manner respectful of teachers' practical knowledge and their classroom reality.
- Print resources are critical communication tools for a new curriculum and valuable supports for teacher implementation—clear and consistent messages must be provided.
- Communication with teachers in the curriculum and resource development phase will improve the quality of the resource and develop trust and rapport if their suggestions are acted upon - demonstrates value placed upon their professional classroom expertise.
- Teleconferences, fax, telephone and a newsletter provided effective means of communicating with teachers.
- School visits/classroom visits are powerful communication opportunities that can directly inform the inservice planning process.
- Communication and cooperation among science teachers in each school (the team approach) is to be encouraged and supported.
- Special provision for teachers working alone in their school to communicate with teachers in other schools should be made.
- Access to ongoing formal and informal implementation assistance and support is needed—teachers must know they can turn to the leadership team for reliable help.
- Communication to create school administration's support for the new program directions and for the teachers implementing the new program is important.
- Student counselling for science course planning is critical; communication with guidance counsellors, students and parents to develop understanding and support is necessary.
- Communications for community awareness and support of new programs are important.
- For high school core programs, communication with post-secondary institutions to create awareness and acceptance of new programs is critical—inservice planners can provide an opportunity to include strong post-secondary institution representation—if possible, involve those who have the power to make decisions or influence decisions on the acceptance of the program.

- The Internet has great potential to increase the efficiency and effectiveness of communication between all those involved in such inservice projects—it could be a powerful addition to the many other types of communication used in such a project

Trust and Rapport

The development of an atmosphere of collegiality and trust between the leadership Science Team and project teachers is closely tied the leadership, the communications and the reflective and responsive process employed. Key points already raised under each of these topic areas all relate directly or indirectly to the development project trust and rapport. The rapport and trust between the field validation teachers and the Science Team, that was so critical to not only meaningful comments in the journals leading to the planning and implementation of meaningful inservice activities, evolved because:

- the leadership team were seconded or contracted teachers who were known and respected in the field as competent science educators
- leadership team members, although passionate believers in the new program directions, were open to the opinions, concerns and ideas expressed by the teachers. They showed respect for the teachers professional expertise, carefully considering their input and making changes in the programs and/or resources as appropriate. This built confidence in the process
- honest and thoughtful consideration was given to all the journal comments and changes in inservice activities that were made in response to commonly held concerns or workable suggestions by the Science Team
- leadership team members participated fully in the inservice sessions alongside teachers and completed their journals.

The following list of key points includes additional factors that were identified as important in developing positive momentum within the project.

Key Points

- Value teacher expertise, maximize teacher leadership and involvement in program and resource development and formally and informally recognize teachers effort and leadership.
- Respect the diversity of school environments and perspectives on the proposed changes–teacher support (inservice, resources, communications) should be relevant to the teachers' needs and the reality they face in the classroom.
- Provide sufficient inservice time for teacher awareness, commitment and implementation skills to develop time for trust and rapport—long term projects have greater potential for success.
- Maximize the teacher support within the bounds of the resources available—use partnerships with other organizations to supplement resources available from the central development agency.
- Develop inservice programs and support resources to meet the needs identified by the teachers while also meeting the goals of the new curriculum—an ongoing consultative process with project teachers.
- Appropriate student and teacher resources must be available on time.

- Curriculum and evaluation development leaders must share a common vision for implementation and provide clear and consistent messages and materials for teachers.
- Student evaluation and assessment is a major focus for students, teachers, administrators and parents - particularly the centrally developed examinations administered for the graduation level courses and it must be well defined and supported with resources—teachers need to be involved in the evolution of these strategies/instruments.
- Quality of venue, food services and accommodation must be appropriate.

The Challenge Remains

During the field validation and implementation of the new senior high science curriculum in Alberta, less than 10 percent of the total senior high science teaching force were involved in the inservice project described in this study. The remaining teachers may have attended single day information sessions offered in the Spring each year by the Alberta Education Science Team and field validation teachers or a related session or two at professional conferences. They were not placed in an environment that provided the time or the opportunity for in-depth exploration of their paradigms of science teaching and extensive interaction and collaboration with colleagues. They did not have the same direct involvement in the evolution of curriculum and resources, nor the access to direct and ongoing support from Alberta Education. The Science Team interview comments, and comments made by teachers in their journals, reflected the view that as a minimum all senior high science teachers in Alberta should be involved in the same type of professional development experience that the inservice project provided. A desire for some type of ongoing and ever-evolving process of professional development for teachers was expressed by a team member—an "evergreen" approach rather than complete curriculum revision and implementation periods of frantic activity to be followed by years of relative stability.

It was clear from past curriculum implementations in Alberta, and from similar implementation initiatives around the world, that the providing extensive inservice to a small percentage of the teachers in hopes that they will provide the leadership needed to assure implementation by the rest of the teachers is ineffective. This "Cascade Model", although not effective in supporting total implementation, remains the fallback position for many central curriculum implementation initiatives. The immediate costs of providing such an intensive inservice experience for all teachers is a barrier to central curriculum development agencies, such as Alberta Education taking responsibility for provision of inservice for all teachers. In the case of the senior high science curriculum implementation, Alberta Education provided the leadership and resources to allow a solid and successful inservice program with the field validation teachers. However, for teachers beyond the field validation teacher group the amount and quality of teacher inservice available was inconsistent or non-existent and certainly would not compare to the inservice experience of the field validation teacher group. The age old question of who has responsibility for provision of professional development activities in times of curriculum change rears it's ugly head. What is the responsibility of the teacher as a professional, of the post-secondary institutions, of teachers' professional associations, of school jurisdictions, and of business and industry in relation to the central curriculum development agency?

In Alberta, these questions remain unanswered and politically charged. Generally, centrally developed curriculum is implemented with inservice being provided by Alberta Education only to the teachers field validating the new programs. In the Senior High Science curriculum development and implementation, huge resources were provided for a broadly consultative curriculum and resource development phase with relatively few resources being allocated to teacher inservice—it was only the field validation teachers who received direct inservice from Alberta Education. Although a relatively small amount of resources were allocated to inservice in this particular project, these resources were much larger than average due to the high political controversy that swirled around this implementation. In addition to providing inservice to the field validation teachers, Alberta Education provided considerable funding to all Alberta school jurisdictions for use in professional development activities for the rest of the teachers in the province who would be implementing the new science programs. This funding to school jurisdictions was a direct per pupil grant with no stipulation as to how it should be spent. Teachers were generally unaware of this grant and in many cases the funds granted disappeared into general coffers of the school jurisdiction and were likely used for other purposes. Because many school jurisdictions did not provide their senior high teachers with inservice opportunities, many teachers faced the implementation of the new curriculum with little or no preparation.

In Alberta, for political and historical reasons, there is very little formal collaboration between the various stakeholders to provide cooperative planning and action on teacher inservice during times of curriculum implementation. Good intentions and goodwill may be expressed by any or all stakeholders but cooperative action is rare or non-existent. Underlying tension between these various groups is common and can create a very negative environment for curriculum implementation. I suspect that these problems stem from other important questions regarding development of curriculum, questions such as who should be involved and to what extent? When organizations or individuals do not feel they have had sufficient voice in the curriculum development phase and that new curriculum is being imposed upon them, their spirit of cooperation lags. It would be worthwhile to explore the possibilities for the various stakeholders, including the teachers themselves, to collaborate and to provide professional development opportunities, such as those experienced by the teachers in this project for all teachers on an ongoing basis.

A Successful Model

The findings of this study of the Senior High Science field validation inservice planning and implementation process indicate that the process was viewed by the teachers and Alberta Education Science Team leaders as successful. Many factors contributed to the success of this project; the reflective and responsiveness of the process, the leadership, the communication and the development of trust and rapport. The three-year term of the project provided the time needed for changes in teachers' functional paradigms to evolve in an environment conducive to reflective practice. The study provides an example of what can be accomplished with teachers and by teachers when sufficient time and resources for inservice and ongoing implementation support are available. All Alberta senior high science teachers would have benefited from an inservice experience similar to that provided for the field validation teachers before and during implementation of the new curriculum.

For Further Research

Some questions and issues for further research related to this study would be:

1. Investigate the field validation teachers' perceptions of the inservice and implementation process in which they had participated by going beyond the journal data presented in this study; i.e., What could in-depth interviews and reflective writing combined with school and classroom visits reveal? Perhaps a case study of five or six teacher inservice participants might be attempted—teachers with a variety of initial attitudes to the inservice and implementation (resistant, undecided and supportive).

2. What are feasible improvements and alternatives to top–down curriculum inservice and implementation?

    a) How could practicing teachers, educational administrators (school and school jurisdiction), post-secondary educators/researchers, teachers' professional associations and the government central curriculum agency effectively collaborate to provide appropriate inservice experiences for **all** teachers implementing new curriculum?

    b) How could curriculum change and the professional development associated with such changes be collaborative and ever evolving rather than top–down, periodic and time limited?

3. Teachers cope with curriculum change in a variety of ways. What are the characteristics of teachers who are positive and flexible in attitude and who adapt readily compared to those who are more negative, inflexible and resistant to change in practice?

4. Can key agents for change within various education stakeholder groups be identified? If so how do they fit into the possibility of ongoing, collaborative evolution of curriculum and professional practice? One could examine a relatively successful curriculum implementation to identify the key individuals involved from the various stakeholder groups, their attitudes toward change, their beliefs about education and the relationship of such key individuals across stakeholder organizations. Perhaps such collaboration could be more effectively encouraged by networking these like-minded individuals rather than the larger task of networking their various organizations in a more formal relationship.

> We must ingrain in society the kind of capacity for educational change that inevitably generates its own checks and balances and lines of solution in situations that will always be somewhat out of control, even if we do everything right. (Fullan, 1993, p. 7)

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Appendix A

Personal Journal

Science 10 Inservice Sessions

June 24, 25, 26, 1991 and August 29, 30, 1991

Initial Perceptions

I am feeling . . .

I want to know . . .

I expect these workshops to . . .

Science 10 will . . .

My students will . . .

Personal Perceptions
-Media And Technology

I intend to follow-up by . . .

Media and Technology are . . .

This Workshop was . . .

I would like to know more about . . .

`My students will . . .`

If I were running these sessions I would . . .

Personal Perceptions
-Teaching for Thinking

I intend to follow-up
by . . .

Teaching for Thinking is . . .

This Workshop was . . .

I would like to know more about . . .

My students will . . .

If I were running these sessions I would . . .

Personal Perceptions
-Focus on Research

Focus on Research is . . .

Personal Perceptions
-STS Strategies

STS Strategies are . . .

Personal Perceptions
-Evaluation and Assessment

Evaluation and Assessment is . . .

Personal Perceptions
-Energy, Matter and Change

Energy, Matter and Change are . . .

Personal Perceptions
-Unit I Workshop

Unit I, Science 10 will . . .

Personal Perceptions
-Unit II Workshop

Unit II, Science 10 will . . .

Personal Perceptions
-Unit III Workshop

Unit III, Science 10 will . . .

Personal Perceptions
-Unit IV Workshop

Unit IV, Science 10 will . . .

Appendix B

January 16, 1996
Bev Romanyshyn
#222 - 10508-119 Street
Edmonton, Alberta T5H 4M1

Dear Desiree,

I am writing to request your participation in a group interview involving the Alberta Education Curriculum Branch Science Team. This interview will be an important part of the data I will consider as I complete my thesis study. My thesis is a case study of the field validation teacher inservice component of the new Senior High Science Curriculum project that you and the rest of the Science Team helped plan and implement. I have included a draft copy of Chapter 1 of my thesis study to provide you with a context for this interview.

I will conduct this interview at my home on February 2, 1996 from 7:00 to 8:30 PM. The interview will be videotaped and audio-taped by Rod McConnell to allow for future analysis. Should you agree to participate please complete the attached consent form and bring it with you to the interview. The form requests you to provide signed consent to record your part of this interview and to use selected quotes in my thesis study.

Six years have past since the initial field validation teacher inservice planning began and almost three years have past since the last session was implemented. To refresh your memory of the inservice project period, I have enclosed copies of Alberta Education letters, session schedules and related information that was provided to the inservice participants during the project.

I would ask that you come to the interview with three words or short phrases that capture important aspects of your experience of the inservice planning, implementation and leadership process. We will share these short descriptions to get the interview started. I anticipate three or so questions and then some time for open discussion.

I look forward to the reunion of the Science Team at this interview and hope that you will be able to attend. Please contact me at 453-4438 (home) or 422-3245 (work) if you have any questions regarding the group interview.

Best Regards,

Bev Romanyshyn

Bev Romanyshyn

Science Team Group Interview Participants - February 2, 1996

Curriculum Standards Branch

Senior High Science Program Manager - started as Program Manager in July 1988 and is currently continuing in this position - seconded to Student Evaluation Branch 1986-1988 from County of Smoky Lake #13 to work as a test development specialist (project position). Moved to Curriculum Standards Branch to become Program Manager (project position).

Science 10-20-30 Program Consultant - seconded from Edmonton Public Schools, August 1990 -June 1992. Returned to a high school science department head position and taught Science 10-20-30 and Chemistry 20-30.

Biology 20-30 Program Consultant 1- Seconded from the University of Alberta Faculty of Science, May 1990 - September 1992. Returned to conducting research and teaching in biological sciences at the university.

Biology 20-30 Program Consultant 2 - seconded from City of Leduc #297, August 1991 - July 1993. Returned to teaching and taught Science 10-20-30 and Biology 20-30. President of the Alberta Teachers' Association Science Council (1995-96).

Chemistry 20-30 Program Consultant- contracted September 1988- continues as a senior high science program consultant. Graduate Student, University of Alberta, Faculty of Education, 1992-96.

Physics 20-30 Program Consultant - seconded from Edmonton Public Schools February 1989 - June 1992. Returned to teaching and taught Science 10 and Physics 20-30. Currently seconded to provide curriculuar leadeship in the production of videos supporting the new senior high physics programs.

Project Assistant, Inservice and Resources (unable to attend - interviewed separately Feb. 17, 1996) - seconded from Sturgeon School Division. Returned to Sturgeon School Division as science department head and taught Science 10-20-30, Chemistry 20-30 and Biology 20-30. Graduate Student, University of Alberta, Faculty of Education 1992-96.

Student Evaluation Branch

Science 30 Diploma Exam Manager - seconded Sept.1992 form the County of Strathcona and currently continuing in this position.

Science Team Group Interview Questions

Introduction

We will begin this interview by having you share the three words or short phrases that capture important aspects of your experience of the inservice planning, implementation and leadership process. We won't discuss these but just present them to the group without comment.

Question 1

When you think about the actual inservice planning process what do you recall and would you have any comments about that.

Question 2

I'd like you to think about your own specific role at the inservice - what you did personally.

Question 3

I'd like a quick comment that focuses in on the teachers' journals.

Question 4

If you could have unlimited freedom and resources, beyond what we had available for this project, what would you wish for the inservice component.

05/03/96

Introduction

Interviewer
We will begin this interview by having you share the three words or short phrases that capture important aspects of your experience of the inservice planning, implementation and leadership process. We won't discuss these but just present them to the group.

#1 - Unprecedented and unmatched change, leaping the chasm, success and its prerequisites

#2 - I don't know why but this is what came mind when I though of the inservice sessions but it was the learning cycle - I thought that it was a significant insight that we and many people gained into the implementation of the program.

#3 - Historic, exciting, frustrating

#4 - Non-involvement because much of this came up after I left, pleasure at the fact that you were involved in orchestrating it and satisfaction from the feedback I heard from the people participating in it and it was going so well.

#5 - Innovation, commitment and challenge

#6 - I guess enthusiastic when I think of the teachers that were there, extremely motivational for the ones that were there and myself and very informative.

#7 - While I came in at the opposite end of what you did, I came at the tail end, and the two things that struck me most was the change and all the things that happened around that change and the close knit team that was working in Curriculum on the project.

#8 - One would be trepidation or apprehension, anticipation and collaboration.

Question 1

Interviewer - When you think about the actual inservice planning process what do you recall and would you have any comments about that.

#7 - Struck by how close the team was and how well we worked together - it seemed to me that you guys knew everybody because you had been working with the teachers so much that you knew where they were and what they taught so that you were totally involved with the teachers that were participating in this. That's what struck me the most.

Some frustration and some tension and that comes whenever you make a huge change there is always going to be a faction of resistance and there was resistance from various areas, and there was pushing and shoving on you from all different directions and that is what forced you to get into such a tight team. But I guess in terms of the personal dynamics that you may have not seen from the inside I saw it very - you guys had a us against the world attitude when I joined the team. To some extent, mostly 99% was good but in my estimation there was a bit of group think happening where you wanted to maybe defend what you were doing because you had put so much work into it but all in all you made a great team and you made some great changes against a lot of obstacles.

#6- The thing that struck me most of all was how well we worked together and how we shared everything - that when crises came everybody jumped in and when we had problems with one thing or problems with another or tried to get ideas there was all kinds of cooperation, sharing and support. The other thing I think of more the last year and probably more in Lethbridge than anything else was the tension of some meetings where we expected things might not work as well as we hoped and they ended up actually working better than we hoped but that we would share that anxiety and spread it amongst the group and go in each supporting one another and I thought that was really neat. It was the first time I had worked in a group where nobody fought and everybody worked for the common good - it was probably the most rewarding experience in terms of group work and effort I have ever been involved in.

#5 - Well specifically to the planning process I was sure glad #6 joined us. I felt the planning process was very thorough and inclusive, of covering all the basis particularly since it was important to as #4 has intimated that we had to win people over and one of the significant hurdles was to demonstrate that there was a commitment by Alberta Education to support this change and get the teachers involved and up to speed and in the planning process I think that was addressed in terms of looking at having high quality inservice activities as well as social activities where people could become comfortable with the group and the programs.

#4 - Recollections I would echo the pleasure of the group work and it is worthy of reinforcement. Going back to the early days when you were trying to get things going, you were making presentations as to what you were going to be doing I still have this fixation with a meeting at the APEGGA offices where you made a wonderful presentation in the afternoon and I was totally preoccupied by the chaos that had gone on in the morning. So that to me was a wonderful juxtaposition - The down side of certain decisions being made for political reasons and your wonderfully forward thinking and positive attitude which I thought was the route we should be following and would have taken us a lot further along a lot more quickly rather than going back and reinventing the wheel as we were being forced to from the morning meetings. I also remember seeing some of the inservice materials being laid out and thinking just how interesting they were, how stimulating they were and I really thought that was a good sign because I could see there that teachers were being exposed to what we were trying to achieve in the curriculum documents. So for me that was my first sense that the rubber really would hit the road and this is what it meant when you translated it into action so I was really pleased to see what was going on there because it really started to bring it home for me that it really wasn't just abstract theory that there really was a practice that was involved.

#3 - One was the scale of the whole operation that really was historic in terms of the size of the field validation that was undertaken. I was really glad you were running it because of those spread sheets that you had keeping track of all of the teachers and setting up the sessions at U of A, U of L and U of C with all the sessions going on and I was glad you were working on that part and I only had to work on my bit and I certainly support what was said about the group spirit within the team in the Curriculum Branch working together and I got the benefit of most of that cooperation because being responsible for Science 10-20-30 I had overlap with all of the disciplines and it was exciting to learn about these disciplines more things than just the chemistry that I had been working with and it was exciting too when some teachers in the field test got quite excited about some aspects of the Science 10, 20 and 30 and they became salespersons, spokespersons for the program, that was really exciting. They had an advantage over me because they had actually taught it and at that point I was still working at the Department and hadn't actually been in the classroom with it. The frustrating aspect was always having to articulate what Science 20-30 was for, like who really needs it - and not just with teachers but I felt frustration that our leaders within the Curriculum Branch were not very clear in their own mind as some would try and sell it as a panacea - take Science 10-20-30 and you don't need any of the disciplines which made no sense and we weren't really promoting that- so it wasn't easy for us to make a very clear description of who Science 20-30 could really be for so there was that uncertain ground that that program was on. I think the other thing I remember as we went through it is how it gained momentum with each successive session. U of A was a lot of frustration, a lot of the teachers getting to find out what this was about and being kind of shocked at how much work they were going to have to do and then Lethbridge was surprisingly better than we thought and Calgary was a great way to end the whole thing.

#2- I guess for me I can't separate the leadership you gave from the planning because I think that without your leadership we wouldn't have been able to…you gave us the freedom to just dream up what we thought was good while at the same time you were bringing forth ideas for us to consider and facilitating the work we were doing. I just for me planning is really closely intertwined with your leadership in this whole project. The work itself well I guess I would say what everyone else said, it was very rewarding I found. It was frustrating at times as we were scrambling to think of what is the best way to forward our thought on the program and bring teachers around to except the changes but I found it very rewarding to be able to … again I think of you - that you gave me the opportunity to just think of what would be a good inservice for this particular part of the program and so I really appreciated that - that was a great part for me. The other thing about the planning was to think of how it evolved to include more and more people. At first it was just us sitting around trying to dream up some schemes that would be good inservice and I think we had good ideas but then it evolved to involve people we had involved previously and we networked outwards and we used the teachers in the planning and they became and important part of it and so that sort of the three things - your leadership, our group work and you giving us the opportunity to do what we had to do and then how it evolved to involve more and more people.

#1 - I would agree with everything that has been said and I can't emphasize the team effort that was put into the planning of it. Your role was certainly pivotal in planning the inservices and I think each of the consultants had a very major role to play in terms of planning some of the specific activities so between the planning and the specific activities we had a good range of capabilities to provide that kink of an inservice.

When I think back on the whole planning process, (I am going to take a slightly different perspective on this), to me there was always the question with the teacher inservice of how do we provide the teachers the necessary capabilities to be able to deal with the vision for the new science program and while we use the word vision to encompass a whole constellation of things I think what we were trying to do with the new science programs and to some degree perhaps are still attempting to do this by in large successfully, is that we have redefined by this new program: the concept of nature of science-that has changed, bringing in STS is a very important part of that -we were looking at a new definition of what we think the learner is- and #2 alluded earlier about the learning cycle which encompasses some of those new concepts,and when you take those two together you change the nature of science education - its activity based, something much broader than simply the knowledge component of science. By the way people who still refer to science education as content tells me where they are at in terms of how they think about science education and of course trying to implement "scientific literacy".

So to me when I said earlier the planning really allowed us to try and bridge that chasm, because when you think about it there was a lot of resistance to the change, it was a very controversial change, it was representing a totally new paradigm, and we were asking people to make that change. The field validation teachers we had selected deliberately to reflect the broad range of classroom teachers that we had. Consequently, there were a number of opinions that folks had, and again I would echo a statement that I heard earlier that as we went from University of Alberta to Lethbridge to Calgary we learned a lot , - simple things such as if you keep people reasonably comfortable and feed them well they perhaps more eager to show up the next day to do things. But you learn things like this along the way and we as a team were certainly on a learning curve as were the teachers and what really impressed me most was that the fact that the inservices began to build a lot momentum on their own so that tells a lot about the planning process and it tells a lot about how we made more attempts to bring in folks who shared the vision to help us deliver that particular vision as well. So in terms of planning those inservices I would suggest that they were done extremely well and I think if people were engaged in this kind of activity again I would certainly recommend that they use our planning model as a template to build upon.

#8 - I remember in the first year of the planning being very apprehensive about or very concerned about how the teachers were going to react to everything. There had been so much negative feedback and nervousness about the programs that I was a little bit afraid or nervous about how everything was going to go with all these people. So I remember being nervous about how everything was going to go, did we think of everything, did we have everything planned, were there going to be any glitches that would come along that we hadn't anticipated. I had never been involved in organizing or planning anything of this magnitude before. I was also kind of excited about the whole thing because we had spent so much time and effort getting the everything organized with the Teacher Resource Manuals and setting up all the speakers coming in and so on that I was really looking forward to sitting in on some sessions and seeing how it would all go.

The second year I remember feeling a lot less nervous about the whole situation - a little bit concerned about the University of Lethbridge and wondering because we didn't have access to all the same schools to pick up equipment if things didn't go quite the same we were dealing with a situation that was hundreds of miles away from home and how were things going to work out that way but everything went along just tickety-boo.

And then the third year I remember really looking forward to it because at that point I'd taught the Science 10 and Science 20 and so I'd had the opportunity to implement some of the things that we had gone through in the first two inservices and I was really looking forward to spending some time with my colleagues from the school and also looking forward to getting some new ideas or suggestions from the sessions - not having to worry about all the planning and being able to enjoy it for a change.

Question 2

Interviewer

I'd like you to think about your own specific role at the inservice - what you did personally.

#1 - The first role was to listen to what people are actually saying and often engaging folks in some sort of a dialogue to see how things were coming along. One of the questions I always asked them was" well how's it going and what things had been working" and so on and so forth - to get a sense of where things were at because I was really trying to gauge what impact we were having on people during that particular process. But in terms of the overall inservice activities I was trying to see whether or not we were on course in terms of how things were actually changing - so how and why the activities were being framed, and were the activities in fact going to be providing for those major links among the different sciences that we considered very important and what was the big overall plan that we had for year one, year two and for year three. So, in one way, I served at looking down the road and seeing how things were going and basically serving as an emollient to make sure that everyone was enjoying themselves as well.

#2 - I guess I saw myself taking two roles - the one mentioned of a observer, I think that was an important role. I was curious to know what these teachers were thinking and how they were internalizing the massive changes and I didn't realize how massive it was for them - it is more in retrospect - we had this naïve notion that they would see this is all great stuff and just go ahead and teach it. It was very interesting to observe how different individuals reacted. That is one of the most fascinating things about this whole thing is how different personalities adapt to change and that was a fascinating part of this and of course trying to incorporate some of what I observed at the first inservice into some of the things I though we maybe should be doing then for the second or in our documents - sort of adjusting to what observed there. And I guess the second in a leadership role because people were looking to me as the person who knew something about the changes, particularly in the chemistry area. I guess I was probably less comfortable with that because when you have such a change and I haven't actually gone out and taught it myself in the classroom I didn't feel real comfortable with standing up there and saying this is really good stuff. Probably a highlight for me was, I believe it was Lethbridge, was the session with the chemistry based activities - there was just such a high energy level and interest in that session. People were just practically bouncing off the walls as I recall and the room was just packed and so much excitement and so much input - people telling you well why don't you try this with this activity or I did this and it worked. It was almost the ideal session if I ever had one there - it just wasn't me telling. I had put out some stuff and people looked at it and were talking to each other about it and then they were telling me about how it could be improved and telling each other about their experiences. It was great fun.

#3 - One role that I recall was to talk about the organization of Science 10-20-30 and trying to put together some materials that would show how you could organize the course around some unifying themes like energy matter and change and working up some overheads and speaking to them on that to show how you didn't have to organize a course around chunks of disciplines and that seemed to be meaningful to a number of people. They hadn't really thought of how energy and matter run through all the disciplines and so that was worthwhile. And then in the other part, the hands on work with the materials, I always dealt with the unit that wasn't specifically or closely related to biology, chemistry or physics so Unit 1 of Science 10, Unit 1 of science 20 or Unit 4 of Science 30, and enjoyed working with that. Usually people from the university who had particular interest in the earth science, meteorology or the energy field and we had some good people there to work with and those were the sort of the integrating units usually. And then there was the role mentioned by #1 and #2 as well as being kind of some one to listen. I felt that in the inservice they were there for three or four days usually it was a more thoughtful environment in which you could discuss with the person what it was that was bothering them or what is was that they liked about the program not nearly as confrontational as the information sessions we had where we went out to talk to groups of teachers where I felt more like a lightning rod then a listening person. (At the inservices) you could work out some of these things and learn from it and I think they could learn from me as well.

#5 - I guess that's where my word challenge came from - the challenge being to offer the teachers what it is they require to make this shift in presenting the subject matter and the kind of teaching methods and approaches they needed to adopt for this program. Working with what in comparison is the black and white part of the sciences presented a different challenge because until very late in the process there was a certain antagonism towards the topic - physics and mathematics seem to create an anxiety in people that had to be won over or overcome and presented as a result an additional stumbling block to the acceptance of the change. As far as the specific roles, the role of observer that was going on particularly in the first sessions at the U of A was an interesting one. At the U of L and U of C I was more hands on involvement that was more satisfying to me personally. The frustration of the exercise for me, particularly the Science portion of the course was that people expected to have activities that were verification activities, experiments that always give you 100% success. I am sure that I antagonized many by insisting that all experiments work - it is just that you have to look at your results and interpret them appropriately. If they aren't the results you expect and then you ask the question why not and take that into a learning experience. I'm sure there are a few teachers around the province that would rather throw rocks at me than speak to me.

Nevertheless I think, and particularly in retrospect the overall personal satisfaction was the amount of learning I was able to do through this particular process and I wouldn't even think twice to do it again.

#6 - Sometimes when you said that last statement #5, I think of A team on TV - where we would all be in retirement and somebody phones and said we need you and I think we would all be there on the doorstep to do it all again and that's quite amazing. I have never had a chance to say this before and I don't know if this is the time to say it but I felt like a lot of you- I don't know what we would have done without us when disaster struck you seemed to be able to solve the problem, Bev. When we used to referred to you as our den mother I think that was very true, you fed us on the road, you made sure our rooms were organized. One thing I did enjoy so much, I hate to admit to #5 - I hate admit that I had a fear of physics up until I met #5, then I had a fear of #5. It was nice to go to the sessions and the physics sessions I enjoyed more than the biology sections - mine, I remember lugging dead animals around from city to city in a big bucket and it was so nice to see that physics was unpredictable too because mine certainly didn't live. I enjoyed physics, I realized that it was so nice to not have that fear of physics and I especially enjoyed the accident reconstruction activities in Lethbridge. I loved to watch the teachers unlock their potential as the sessions, particularly in Lethbridge and Calgary one where teachers started to realize that they could do all these things and it wasn't as scary and they had the potential and knowledge and ability to do it. It was nice to listen to the teachers dealing with change.

There were frustrating times to dealing with teachers who were very rigid in their points of view and who were upset because their old world had crumbled around them and physiology was no longer biology and how were they going to cope with things that they had always dealt with and in most of the teachers that had almost disappeared by the last inservice - there still a few remnants, pockets of resistance in a war where they just have to clean them up a little bit. I enjoyed the workshop sessions especially because I never knew what we would get when we showed up in the room and I enjoyed kibitzing with #5, I used to be afraid of him when I first got there because I took him seriously. It was wonderful to see the teachers - it was wonderful to listen to them on the teleconferences too which hasn't been mentioned - and how they helped on another out, and how they offered information and how they were supportive of each another in distance they were all scattered across the province but it was like a family, a huge extended family and with almost few exceptions they stuck together and they followed it through and it was terrific to watch . I don't think I have ever been involved in such a mega project that was so rewarding and I learned so much, I just learned so much.

#1 - I though of it as a community, the inservices - building a sense of community, I felt that was very strong as well.

#6 - I felt a tremendous sense of loyalty toward the end toward the whole cause throughout all the teachers and the team.

#7 - My job was to try communicate to the teachers how evaluation was going to fit in with the new curriculum and also to observe how the teachers were viewing that and to see how fast we could go in evaluation. I had a very attentive audience because they really wanted to know what was going to happen with evaluation I was newer than the teachers and I was just trying to wrap my mind around how to make the exams as forward thinking as the program of studies was and to reflect the program of studies. I learned a lot and the teachers were very receptive - I found that with few exceptions they were willing to try to innovate on the evaluation side of things too. We just commented in a meeting at evaluation how when the new courses were first being implemented was one of the best times the student evaluation branch has been through because we all had to get together and compare our philosophies - it is still being done now but we just said that we have to avoid falling into the rut of being satisfied with where it is now and keep hammering away at each other and I think that was a valuable lesson to go to the field and try to learn what they wanted for the evaluation and at the same time try to communicate how the evaluation was going to parallel the program of studies.

#2 - It is interesting to me how there has been a shift. First we were the ones out in the field, we were the ones meeting together and talking to the teachers and now that has shifted to you folks in evaluation and I'm hearing feedback from the field more through you now than from anything I'm doing.

#7 - It was really tough. At first we went through what you guys went through because of change but to a very much smaller degree because you guys had made the big change. but we got the comment and you were there during some of my presentations where people were saying what is this a social studies exam, is this an English exam, why are we going to these open ended written response items and that sort of thing so we had to break some new ground but not nearly to the same extend. One thing we could have done is just turned around and said it is Curriculum's fault we just simply have to do it because they changed it.

#2 - I think though you have raised finally in a facetious way kind of a serious point that did come up occasionally throughout this process in that sometimes we weren't saying the same thing I felt from my perspective, out of Curriculum and Evaluation and part of that I know is to do with just the way it's structured, our organization is structured. I sometimes felt that some of the folks in Evaluation were just a little bit behind in saying what we were saying and I think that part of that was that we weren't getting together and working together enough because of the structure of the organization.

#1 - But I think the organization has recognized that and has taken corrective measures - we are working far more closely now than we have ever done previously which I think if a very good sign.

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#3 - As someone out in the field now I really appreciate the diploma exams and how they reflect I think the spirit of the new courses, not only in Science 30 but Chemistry 30 as well - the open ended questions, the STS and so on. I get quite a bit of satisfaction out of seeing very conservative teachers now having to take this quite seriously - it makes quite a difference as to how you have to approach it - you really have to dig in and get into the program of studies and see what the framework is.

#7 - I hope that we don't get satisfied with how far we have come. Because I think its really vital now the Evaluation and Curriculum even keep working more closely together. We have had such a turnover in Student Evaluation that I think the next step is to into have an real advantage for kids who have done some real good research work as opposed to a lot of knowledge type of stuff and also an activist type of approach where you go to the next step in STS, so we know what the problems are so what can citizens do about it. So I keep we keep going in that and not be satisfied with where we are.

#6 - There was a very positive thing that happened this week. There is a staff member with whom I have worked for many years and he is a very conservative man, very traditional. He spoke out at a staff meeting and he gave probably the nicest compliment we all could have received. He taught Science 30 for the first time in his life and was somewhat shocked that he was going to have to teach it I guess. But having taught it and having taught some of the other parts of the new program he said at the meeting that this is one of the finest curriculums probably on this continent and it is so flexible and so I guess "right on", (I can't think of a word that he would have said), but here is a person who was dragged into this program kicking and screaming all the way and all of a sudden he is sitting in a meeting saying well it is what you make of it, its a terrific program - I can't think of how you could have done it better - we are probably a model for half the provinces and half the states. And I thought, how marvelous having just finished his first round of Science 30 - it's amazing, it's just lovely to see.

#8 - In the first year I was running around, as were you, making sure that everything was OK and that coffee was in the right place and the muffins were where they were supposed to be - that sessions were going OK and that everybody had the stuff that they needed. This was the one where I ended up doing the technology session with John Marean in the IBM lab and the LXR-Test workshop in the Mac computer lab on the first floor. I remember how excited I was about the whole idea of having this neat program that would be able to do all these great and wonderful things when it came to making up tests and quizzes and how much time that would save me if I were in the classroom and thinking how excited I was about trying to get these school to work together on making exams and sharing the pool of questions so that all of us would have life a lot easier and realizing that so many teachers were so far behind where I was in the whole technology scheme of things that they weren't near as excited about the whole thing as I was. There were few exceptions but that was a little bit disheartening, was realizing that in that workshop there were people who had negative reactions to things and also seeing that in some of the other sessions as well - that there were people who were very nervous about the new programs and they didn't want things to change. I also really remember the University of Calgary and the last year - the tours and how wonderful they were and the whole change in atmosphere. I don't know how much of it was because I'd been back in the classroom and so I started to feel much more of a colleague with the other teachers instead of one of these Alberta Ed personnel, or if it was just a real change in attitude that the other teachers had that there was a lot more excitement about teaching the programs and the opportunities that it could afford to the teachers.

Question 3

Interviewer

I'd like a quick comment that focuses in on the teachers' journals.

#1 - That is a question I haven't really thought of because I had other things I wanted to say about this particular process and since the camera is on me I am going to say them anyway. I think the journals were important in that they allowed folks to critically evaluate what they had done during the day and put

something down on paper and more importantly for me any ways who were given the task of ensuring that we provided a good inservice activity that we had an opportunity to scan what people were thinking, and make changes as appropriate. So, I saw that as a excellent planning tool for seeing where we are, and where we needed to be. I would like to add a couple of things in terms of thinking about the whole process of inservice and everybody has spoken about the real important nature of change - the STS, the new way of looking at the learner - we've talked about the kind group processes we had not only within us as a team, but also with the teachers as well.
I was struck by how many of the teachers really did want to do a good job; it was just that they were not given the support and the necessary where with all to be able to make the leap across the chasm that I talked about earlier. And to me the success of the inservice for field test teachers in my personal view really exposes a major weakness, (and indeed I would make this major criticism of the entire educational system) that we have not just in this province but where ever. That is, we people in government often put policies into place, the policies are often very far reaching, but the support mechanisms are not in place, and I'm not saying that the government necessarily has to do them, but certainly the system has to respond to those particular changes, and I don't think the system is responding fast enough. I think it has really exposed for me the need for really good quality teaching materials to support the changes - many of them are coming on stream. Certainly the work #5 is involved in (video project) is a response to that particular need. I don't think that this change process has stopped - I think it needs to keep going, in fact, I would say that in some respects it needs to be may even need to be accelerated in terms of where it is going.

I think the government has to find a way of when they formulate policy how they go about getting support for the policy before they start implementing policy. Most of the issues we had to deal with at the inservice were not issues that were related to planning issues or the quality of programs that we provided to folks - it had a lot to do with policy based issues, people were against the changes because they didn't see why the policies were being put in place and I think that really does expose the out that systemic failure that I talked about so I guess I'll stop there.

Interviewer - Good, you answered my last question, so that's good -you don't get a turn next time.

#1 - I still have more things I want to say.

#2 - I think any time you give teachers an opportunity to reflect it's a good thing, well that is true for anybody, and so I think by formalizing that reflection process, teachers I think were given an opportunity one, to give feedback, because I think they were thinking I'm speaking to Bev through this journal, some of them, many of them were. Also they were speaking to themselves you know they were going over the things that were running though their mind that they maybe had said to someone or were thinking of late at night but you gave them an opportunity to write it down and reflect upon it and I think anytime someone has a chance to reflect on something they internalize what is happening better, they feel more comfortable with the things that are happening around them so I think journaling is a very good tool. On the negative side some people don't like doing journals, and I detected that in my observations of the teachers - some of them considered it to be not a useful activity I'm sure but I still think that even those by forcing them to do a bit of reflection it was probably a positive for them if you went back to them later on they would probably say that.

#3 - My sense in observing the teachers was that they were reluctant to take this on - this struck them as kind of some new age thing that Bev had dreamed up but once they got into I think they thought there was some value and that reflecting and that it was good to think on these things. And then essentially you were thinking about it and making some notes for yourself and in that sense it is probably symbolic of the whole change process that once you get into it its there is more there than you thought and you can get something out of it if you take a good look at it. So I think the journals kind of reflected the whole change process and looking at things in a new way and people were surprised at what would come of that.

#4 - All I can do is make editorial comments and I think using journals were an innovative and good idea.

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#5 - O.K., on a personal basis I believe the reflection #2 that talked about is a personal issue and I guess I am one of the people who would feel that writing a journal is not an activity that I would keenly participate in a public forum Having said that I think, that as the observations made, by forcing people into that it advanced their learning in the sense that they did take a look at what happened during the day and how they reacted and for some of them it was just an opportunity to just vent their spleen which was a good thing as well because it made the next day that much more productive. In terms of the formalization of writing a journal I would still would side on the side that those the kind of notes speak to notes to myself I guess I like to keep it to myself but it was an excellent exercise.

#6 - I think #5 doesn't want to write journals because he didn't want anyone see that he actually likes biology. I'm not a journal writer - I'm and intermittent journal writer and so when I feel I need to work things out I write them out and when I don't, I don't and I felt that some of the teachers were probably like that. On the other hand it was nice to read through the comments, sometimes to be validated that yes what were doing what was happening was good and they enjoyed it and it was working and sometimes it was good although difficult to read that what you thought was terrific was really not that great and so we had to retool a bit based on the comments and observations because we had to reflect on what they were reflecting upon if that makes any sense so if we look see that if were told by 20 or 30 teachers that they had trouble with this aspect or that aspect that we had to stop and think that maybe there is a problem here. But I would say that that was the more minor part of it - the other part was just seeing that things were just moving along well and the teachers were starting to, I wouldn't say buy in to the whole concept that were being presented to them, I don't like this term "buy-in" but for lack of a better word they were starting to accept the change and the journals I think partially reflected it - I don't know you probably Bev, looked at them in more depth then we did but I think that as the journals progressed they evolved to from the very beginning to the end.

#7 - I regret that I didn't read these journals because I think it is good because what you were doing was forcing the teachers to model what would be nice for them to have their students do. I always found you had to force students to do it but once they did it - hey somebody is actually taking time to read these and listen to what I think- and there is a huge satisfaction from knowing that, that somebody is listening to what I say and responding to it and I don't know if it worked the same with these teachers or not but it really works with students and hopefully by doing it themselves they would see the value with students, that would be wonderful.

#8 -Well I remember the first year hearing a lot of negative comments about the "what use are these things" and "why do I have to sit down and waste my time doing this" and hearing how that changed over time as well. By the third year people would just be writing and writing and writing because they had so much to say about sessions and they were so much more positive about the inservice and the about journal writing. I think probably some of it had to do as well with how hard we worked at trying to change things according to the feedback that they gave us and tried as much as we could to plan to what they felt their needs were.

Question 4

Interviewer

If you could have unlimited freedom and resources, beyond what we had available for this project, what would you wish for the inservice component.

#1 -Yes, one of the things that for us going through this experience has been revealing- I have though about that question quite a bit and I have thought about it in terms of especially some anecdotes where people have said that there were some grants that were provided for school jurisdictions for the purposes of implementation and inservice and that the monies were never really spent for the purposes for which they were designed. We had a teachers' association that expends a considerable sum of money towards inservice and I'm excluding what the Science Council, the specialist councils do from that and one wonders where that money is being spent. We have conventions, we have school boards spending money and folks have made a whole bunch of different estimates in terms of how much money was in fact being spent on teacher inservice in this particular province. So for me what was happening in science was symptomatic for a much, much bigger problem. I was really disheartened to find out that so called leaders of our school systems had no idea or awareness of the kind of change that we were talking about, that schools had a complete lack of appreciation of any sense of strategic planning to implement these programs and I'm not just saying that this happens in science, and I also recognize that science is just one of the areas that need to be attended to by people. Clearly, I think that if the system is to respond to these changes in order to meet the needs of young kids and to do this in a timely way. What I would like to have seen, at the very minimum, is to have had some way of ensuring that our high school science teachers were receiving the same kind of experience as the teachers received at the inservice and may have clearly been able to demonstrate that particular need because of the divergence in the way that the program was implemented in these other systems as opposed to in the field test schools. And I find that enormously frustrating, (I get very angry, I get very angry as a tax payer)because we are obviously providing the money for those things to happen, they did not happen. I get very angry as a program manager because the intent was that this program would meet the needs of most kids and yet those divergences to a great degree still exist. Were it not for fact that the ATA Science Council annual conferences, where some of that was picked up, I don't know where we would be today. I mean, in the terms of the rate of implementation I think we are quite considerably behind, and I think this is something that if you are looking for inservices. This is a problem that has to be dealt with in a much more focused way by bringing different consortia or bringing people to the table using a variety of different strategies to deal with this issue, because in a few years from now we are going to have another science program and how are we going to implement it in an era of shrinking resources. That is the challenge that I put to the education system.

#2 - I think to change people you have to touch them very personally and I think the inservice we provided did that with many teachers but I think it did it with very few of the teachers that were not in the inservice. So I think it just has to be on a much grander scale, there has to be I think some kind of intense workshops that involve almost every teacher that is going to have to deal with these changes and that of course is impractical so I really don't have any good suggestions for how to bring about change. And the other thing from what I've read is that the support that #1 eluded to, particularly of the administration in the school and also with the resources and that is something that we had an opportunity to do something about is to assist in providing and finding the resources. But again, in bringing about change in administrators, that again is how do you help them to understand and then to believe in the change. I am a little, you know, just its sort of personal things that I see with my kids, you know what they are being taught and their stories, it just bothers me a lot that there hasn't been much of a change in many teachers. Even though they have heard the message, they can talk about it, they can use the words that are in the program of studies, I just - some of the examples I have come across are very disheartening. So I really think it has to be a very personal thing, you have to touch them personally with some kind of intense workshops with many more people would be the ideal.

#3 - Well I think that at the very least we would want to provide the kind of inservice to all teachers that we did for the field test teachers so they would get into what the rationale and philosophy of the program. The other thing is I think we would have done better by putting more of our time and energy into developing classroom ready materials that teachers could have used that were in the spirit of the new program - in a sense the teachers then are learning from the concrete and then going to the abstract, I think the same why that students learn. So if you had a number of these learning activities that are all laid out ready to use and teachers work through that with their class and then they begin to get a sense of what this is about and can appreciate the rational, the philosophy, suggestions in the teacher resource manuals about alternate teaching strategies. We talked about it in general terms and then sort of left it for teachers to do them. Like the kind of work that #5 is doing right now would have been excellent to have at the time we were implementing and some of the resources that are available now, for the disciplines, support the sense of the program. And I guess the other thing would be to enhance the networking among teachers. And I think that is still possible with email now and that aspect. We could have, you know, if had the email connections we could have done a lot of great things at that time. I think the phone network we had there, those callback sessions, were good but they were just one particular time of the day, not always convenient to teachers, but there is technology there now that I think that it could really useful.

05/03/96

#4 - What these guys said, I would endorse everything that has been said and I think in perhaps even two years time there will be even more technology that would favour that communication. I think from a personal, very biased point of view, what I would like to have seen was representatives of post-secondary institutions becoming exposed to what was going on in those inservice. I think it would have been a revelation to a lot of them, the quality of work that was being done and the demands that were being made on the students. Reading curriculum documents is very dry but when you actually see the reality of what it means in a lab setting, then I think you take it seriously and it becomes very concrete for you and I think it would have been a wonderful educational opportunity if some of the more critical members of the post-secondary community had been exposed to what those teachers in the inservices were going through because I think it would have been a great marketing tool for the merits of the new program, and whilst I would concede it would be very difficult to involve those individuals, none the less while we are having this best of all possible worlds conversation I think it would have been a laudable activity.

#5 - Again, I'm building on what has been said in the sense that I believe that change if a very slow process and in order to accomplish this effectively what would be ideal would be to have and evergreen kind of policy were you have your inservice on a continual basis and everyone is involved throughout the system. If it is restricted to a one-shot kind of ideas we had I would suggest that we work a little harder to convince our leaders of the merits and have them sell the program as effectively as we each did and particularly you.

#6 - I guess I'll…One thing I think that would have been nice is if all the stakeholders that are still arguing had a clear vision of the vision. If we didn't have problems, I'm speaking of the universities and colleges, the SAITs and NAITs of the world - that they all had the same clear understanding of what was expected in the programs so that when the programs were implemented we wouldn't have the problems that exist now. I would reflect what #2 said too and I would loved to have had all the teachers in the province have the experience that we had and our field test teachers had because that would have cemented the program far better and I think it would have cost less in the long run than it does and I am also going to counter what #1 said. I think there is as much waste and inefficiency and bureaucracy and stubbornness in the upper levels of government as there is in the boards and I don't think it is the educational system that is at fault, I think it's the bureaucracy that is at fault.

#1 - No, when I said system I included government, school boards, schools and universities as part of the system.

#6 - But I think too that we have corruptness that goes at all levels that has to be dealt with when we deal with money being not spent on programs it should have been spent on , we have money being spent on programs that go no where and I think the one part that we miss is the incredible amount of dedicated teachers that I see, a lot in Science Council, and I see working hard and they always do it for nothing and they give it there all. And I think we have to remember it is the ones that are on the first line that are in the classrooms. I think it is like saying boy these new kids they are just terrible, not like we were when we were kids. But it's not true, most kids are pretty terrific and although we have some teachers who I would admit are somewhat less than optimal we have the majority of our teachers which work hard and try the very best they can to implement the programs given the resource that they have, and I think that is something we have to keep in mind. They are our best resource.

#1 - And they need the support to do a good job

#6 - And they are not getting the support.

#1 - And they are not getting it - that was the point I was making.

#6 - From all angles - including the parent. But they still don't quit.

05/03/96

#7 - I have a little different perspective on it . I think that, I am going to get #6's dander up here and say, I think that maybe it is more up to the teachers and teachers' association to do some of the inservice. They do some great things, like going around to the workshops at Science Council, you know the learning that goes on there. If there were some things done to get these experiences to kids that are in the universities right now training to be teachers, if there was some incentive to have new teachers out to those Science Council presentations and have a bit more of a rotation instead of the same people back all the time, those sort of things. If there was some move by teachers in the teacher association to give inservicing during the summer and use that tact on professional development. I don't think that you would find that even if you could inservice all of the teachers the way that you inserviced the pilot teachers that you would be as successful because they weren't in on the whole building process and you would be there as an Alberta Education person trying to give these great ideas that you have never even tried in a classroom yourself. When you brought in classroom teachers to share at these inservices that was a very effective thing but I think that it has to be… I think we as teachers have to take more of the responsibility, individually and as an association to do some of the inservicing, not only of our own professional development but of kids that are in the university right now, kids who are just getting into the classrooms. I think we have to grab that responsibility, not expect, we always expect we are in a welfare state here we always expect the government to do everything for us I don't think we should necessarily - I think we should … as you guys did in your inservices use the classrooms teachers to talk to groups of teachers instead of preaching ourselves. I think that should even go further.

#8 - I think, with unlimited time and resources, it would be nice to have inservice with all of the teachers instead of with the 100-150 teachers we did came in contact with over the three years. There was so much change in attitude towards the programs over the three years that there are still so many teachers that I run into today in marking and item writing sessions now who weren't field test teachers who really don't understand to this day the rationale for the change in the programs, or they don't understand the philosophy and they still have such negative attitudes toward the Science 10-20-30 that it really would have been nice to have them take part in the whole process as well. I think that having the group that we did over the three years we really did cause change in the way that a lot of these teachers viewed everything from teaching strategies, thinking about what's best for the student and spending more time on labs and process skills and changing evaluation strategies - kinds of things that even when I am supervising student teachers right now that I don't see happening with the high school teachers generally, at least it is the rare one that has made the kind of gains that we had (with the field validation teachers). As far as the actual field validation teachers themselves, I would have liked to have provided time and resources for teachers within larger schools to be able to do the common planning. I think it occurred in a few school where there was enough administrative support or there was a little of the extra resources to do the common planning and professional development. I think there were a lot of situations where that didn't occur and it would have been nice to help provide some of that time to make sure that all the teachers had a common spare so they could work on the planning together. It also think it would have been useful to instead of the inservice just in June it would have been nice to have something in January as well because you go through a semester of working on a course and so on - in my case it was Science 10 in semester one and Science 20 in semester two - it would have been nice at the end of semester one to have some inservice, some rejuvenation and so on before continuing on.

Interviewer - Yes, we had that one round of one day callback session the first year and then that was it. And that day wasn't enough. We had a very packed agenda - we broke people into groups and they had a chance to talk back and forth but we were just pushing them through to get as much feedback on the program change rather than catering to their needs.

#8 - That's what I remember - them helping us, not us helping them. One of the things that I do really remember having changed over time within the staff at my school over the course of the three years - prior to the first inservice these people had never talked to one another - the biology guys did their thing and the chemistry guys did their thing and the physics teacher did his thing and there was never any discussion or communication between the disciplines and that even within a discipline often times there wasn't a lot of collaboration or discussion going on. After the first year there was a little bit of it that happened - within our school they started having common exams for Science 10 and they made some attempt with the Science 10 to get together and work but by the time they got to the 30 level courses their was all kinds of discussion. All of a sudden somebody who was teaching Science 10 who didn't know anything about physics was running of to the physics teacher to say "have you got any neat activities that would help me to teach this" and the physics teacher who had no biology background would be coming to the biology specialists and ask for suggestions about how he could handle this or that. There was so much more collegiality - the group began to work together so much more by the end of the third year. That had never happened in all the years I had been there before and talking to the staff it had never occurred before so it has really changed the whole atmosphere of the Science Department out there.

Appendix C

April 29, 1994

Mr. Lloyd Symyrozum
Director
Alberta Education
Curriculum Standards Branch
5th Floor, West, Devonian Building
11160 – Jasper Avenue
Edmonton, AB T5K 0L2

Dear Lloyd:

RE: REQUEST PERMISSION TO USE SENIOR HIGH SCIENCE INSERVICE PLANNING AND IMPLEMENTATION PRJECT DATA AND DOCUMENTS AS A BASIS FOR THESIS RESEARCH

I am presently working on my thesis proposal which involves researching the Alberta Senior High Science Inservice and Implementation project I have been involved in over the last three and a half years. The purpose of the study will be to develop a model useful to inservice planners in similar circumstances; planners charged with providing inservice for teachers inplementing centrally developed curriculum, which calls for considerabable change in teaching practice. Should you grant me permission to use the tracking data I have gathered over the timespan of this project, this material would become a major source of data for my thesis research.

An important source of data would be the synthesis of journal responses of the field validation teachers to the various aspects of the inservice provided along with similar evaluations and teleconference comments regarding inservice and callback sessions. Another source of data would be the actual planning and information documents such as agendas and workshop descriptions. In addition, I hope to interview members of the science team to determine their perspective on the various aspects of the inservice we provided as a team for the field validation teachers. I would assure anonymity in any representative quotes used from teacher responses to inservice activities and would acknowledge any Alberta Education project documents included in the thesis.

I have collected, in the binder accompanying this memo, the relevant project data and documentation in chronological order. It is this material, along with teleconference minutes and a few tapes of sessions with field validation teachers, that I request permission to use.

I would be pleased to provide the Curriculum Standards Branch with a copy of my thesis proposal and/or my completed thesis should you wish one. I look forward to your response as I am eager to begin.

Sincerely,

Bev Romanyshyn

Bev Romanyshyn

BR/sv
Enclosure

Approved*

May 8/94

c.c. Merv. Thornton.

*Please consult with Merv. Thornton regarding branch materials and information you would like to use.

Consent Form
Science Team Group Interview

I provide Bev Romanyshyn with consent to videotape and audio-tape my part of the Alberta Education Science Team group interview to be conducted on February 2, 1996. I understand that this record will be used for research purposes only, providing the data required for the development of an interview summary for her thesis study.

I also provide consent for the use of selected quotes from my comments during the interview within the draft thesis study with the understanding that I will have an opportunity to read over the summary and approve, revise or reject any comments attributed to me.

A list of all Science Team members indicating their responsiblities within the Senior High Science Curriculum Development and Implementation Project is to be included in the appendix of the study. Should I decide after reviewing the interview summary that I do not want my name or Science Team position included in either the appendix, the interview summary or with specific quotes used in the study, anonymity, revision or removal of such references will be provided upon my request.

Name:__________________________

Date: _____________

Appendix D

SENIOR HIGH SCIENCE FIELD VALIDATION PLAN

Introduction

The purpose of field validation is to ensure that the program of studies, learning resources, teacher support materials (for example, the teachers' resource manual), and student evaluation materials (for example, the diploma exam) meet the needs of our students and the community. The results of field testing are used to make any necessary changes to the program of studies and learning resources and to help develop teacher support and student evaluation materials of the highest quality.

Selection of Field Validation Sites

Field validation takes place in many different schools in the province. Factors considered in selecting sites for the senior high science field test include:

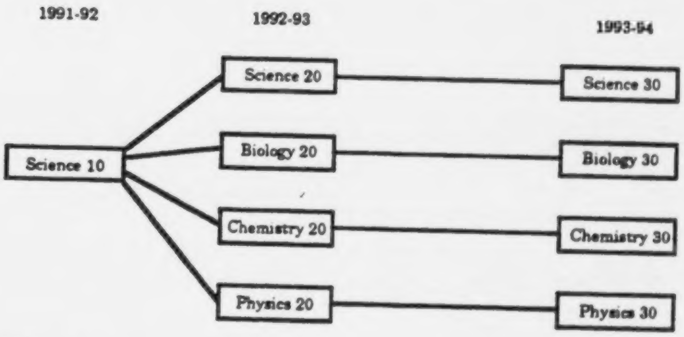
- distribution of schools across all zones
- representation from both public and separate systems
- involvement of urban and rural, large and small schools to reflect the population distribution in Alberta (in some smaller jurisdictions, all schools were selected, as opposed to a single school)
- participation of schools offering programs in both French and English
- student achievement in the schools representative of provincial distributions (based on the diploma examination results)
- agreement by participating schools to field test all of the new science programs.

Field Validation Process

The field validation of all the new senior high science programs will take place in 32 schools across the province. Some 125 teachers and 5000 students will participate. Over half of those teachers, and all of the students, will be involved with the field validation of Science 10 in 1991-92 school year.

The schools involved in field validation are committed for a three-year period. Field testing will begin with Science 10 in Semester I of the 1991-1992 school term and continue until the end of Semester II of the 1993-1994 school term.

Field Test Schedule

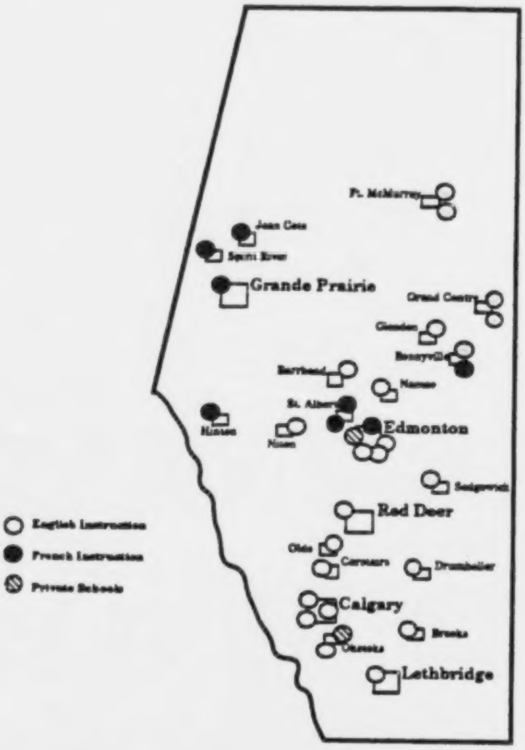


CB 91 05 14 (RW Meet-Val/Proj)

The 5000 students enrolled in Science 10, beginning September 1991, will continue with the subsequent courses (Science 20, Biology 20, Chemistry 20 and Physics 20), beginning September 1992, and with Science 30, Biology 30, Chemistry 30 and Physics 30 in September 1993.

Alberta Education will provide print resources for all students and teachers, as well as professional development activities for the science staff of the schools involved. Although the field test in French will begin in the second semester of each year, both English and French science teachers will be included in the same professional development activities. The teachers involved in field validation will serve as a resource for the professional development of other science teachers who will implement the new programs in the following years.

Distribution of Field Validation Sites


Ft. McMurray
Jean Cote
Spirit River
Grande Prairie
Grand Centre
Glendon
Bonnyville
Barrhead
Namao
St. Albert
Hinton
Niton
Edmonton
Sedgewick
Red Deer
Olds
Carstairs
Drumheller
Calgary
Brooks
Okotoks
Lethbridge
English Instruction
French Instruction
Private Schools

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Dr. Oliver Lantz, Curriculum Branch, Alberta Education

Senior High Science Programs of Study

Vision Senior High Science Programs

Program Rationale and Philosophy

General Learner Expectations

Section 2 Science Classrooms into the 21st Century
Dr. Wally Samiroden, University of Alberta

Section 3 Teaching Strategies

3A Teaching for Thinking
David Blades, University of Alberta

3B Teaching for Conceptual Change
Dr. Heidi Kass, University of Alberta

3C Teacher as Facilitator
Dr. Audrey Chastko, University of Calgary

3D Questioning Techniques
Ed Nicholson, Deputy Superintendent
Lakeland Public School District No. 5460

3E Cooperative Learning
Dr. Audrey Chastko, and Olenka Bilash,
University of Calgary

3F Language for Thinking and Communication
Tara Boyd, Edmonton School District No. 7

3G Effective Use of a Research Process
Teddy Moline, Curriculum Branch, Alberta Education

3H	Periodicals in the Classroom Desiree Hackman, Curriculum Branch, Alberta Education
3I	An STS Context Bob Ritter, University of Alberta (RCSSD No. 7)
3J	Controversial Issues Bob Ritter, University of Alberta (RCSSD No. 7)
3K	Thematic Approach David Blades, University of Alberta
3L	Environmental Connections Dr. Rick Mrazek, University of Lethbridge
3M	Agriculture Connections Daryl Chichak, Curriculum Resource Bank
3N	Technology and Media Dave Jordan, Curriculum Branch, Alberta Education
3O	Traditional and Local Knowledge From Junior High Science Curriculum Document NWT Education and Dr. Gloria Snively
3P	Teaching with Gender Balance Jennifer Smith, Edmonton School District No. 7
3Q	"Microchemistry" and Responsible Disposal Dr. Margaret Ann Armour, University of Alberta
Section 4	**Preparation and Planning** Desiree Hackman, Curriculum Branch, Alberta Education
Section 5	**Assessment and Evaluation** Karen Slevinsky, Edmonton School District No. 7 Terry Grier, Alberta Distance Learning Centre, Alberta Education
Section 6	**Resources** Desiree Hackman, Curriculum Branch, Alberta Education Pamela Shipstone, Alberta Distance Learning Centre, Alberta Education Basic, Teaching, Support and other Resources

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Dr. Oliver Lantz
Science 10 Course of Studies

Specific Learner Expectations

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Section 2 **Specific Learner Expectations**
Learning Cycle Lesson Exemplars by Unit
Monica Quinlan, Father Lacombe High School, Calgary RCSSD No. 1
Bob Ritter, Practicum Associate, University of Alberta (Edmonton RCSSD No. 7)
Stella Shrum, Curriculum Branch, Alberta Education

2A Unit 1 Energy from the Sun
Unit 1 Lesson Exemplars

2B Unit 2 Matter and Energy in Living Systems
Unit 2 Lesson Exemplars

2C Unit 3 Matter and Energy in Chemical Change
Unit 3 Lesson Exemplars

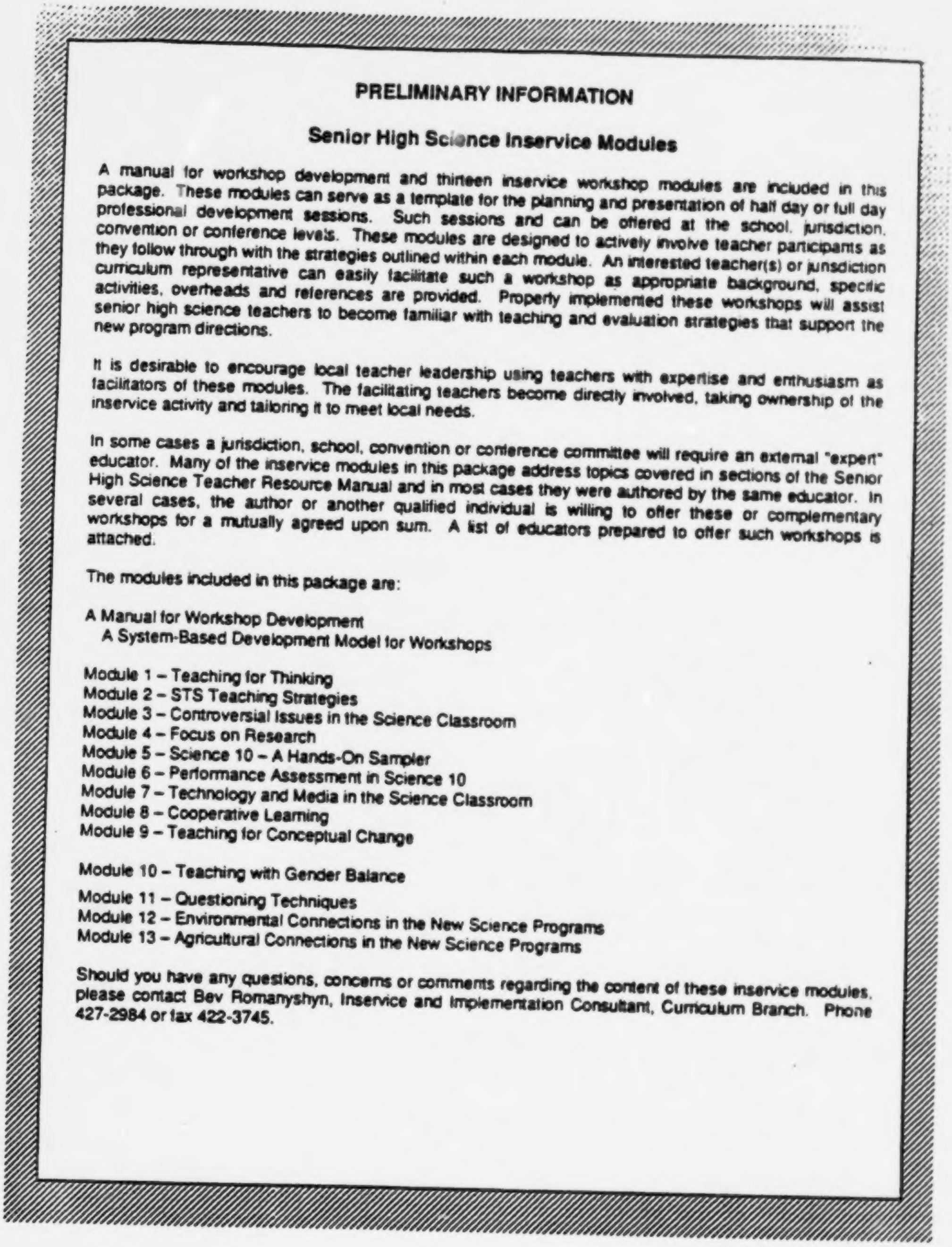
2D Unit 4 Energy and Matter
Unit 4 Lesson Exemplars

Section 3 Concept Connections
Bob Ritter, Practicum Associate, University of Alberta (Edmonton RCSSD No. 7)

Section 4 Cooperative Learning Activities
Pat Adams/Don Johnson, Strathcona-Tweedsmuir School, Okotoks

Section 5 Library Research in Science 10
Gloria Hodgetts/Jeff Goldie, Edmonton Public School District No. 7

Section 6 Resources
Desiree Hackman, Curriculum Branch, Alberta Education
Pamela Shipstone, Alberta Distance Learning Centre, Alberta Education
Basic, Teaching, Support and Other Resources



PRELIMINARY INFORMATION

Senior High Science Inservice Modules

A manual for workshop development and thirteen inservice workshop modules are included in this package. These modules can serve as a template for the planning and presentation of half day or full day professional development sessions. Such sessions and can be offered at the school, jurisdiction, convention or conference levels. These modules are designed to actively involve teacher participants as they follow through with the strategies outlined within each module. An interested teacher(s) or jurisdiction curriculum representative can easily facilitate such a workshop as appropriate background, specific activities, overheads and references are provided. Properly implemented these workshops will assist senior high science teachers to become familiar with teaching and evaluation strategies that support the new program directions.

It is desirable to encourage local teacher leadership using teachers with expertise and enthusiasm as facilitators of these modules. The facilitating teachers become directly involved, taking ownership of the inservice activity and tailoring it to meet local needs.

In some cases a jurisdiction, school, convention or conference committee will require an external "expert" educator. Many of the inservice modules in this package address topics covered in sections of the Senior High Science Teacher Resource Manual and in most cases they were authored by the same educator. In several cases, the author or another qualified individual is willing to offer these or complementary workshops for a mutually agreed upon sum. A list of educators prepared to offer such workshops is attached.

The modules included in this package are:

A Manual for Workshop Development
  A System-Based Development Model for Workshops

Module 1 – Teaching for Thinking
Module 2 – STS Teaching Strategies
Module 3 – Controversial Issues in the Science Classroom
Module 4 – Focus on Research
Module 5 – Science 10 – A Hands-On Sampler
Module 6 – Performance Assessment in Science 10
Module 7 – Technology and Media in the Science Classroom
Module 8 – Cooperative Learning
Module 9 – Teaching for Conceptual Change

Module 10 – Teaching with Gender Balance

Module 11 – Questioning Techniques
Module 12 – Environmental Connections in the New Science Programs
Module 13 – Agricultural Connections in the New Science Programs

Should you have any questions, concerns or comments regarding the content of these inservice modules, please contact Bev Romanyshyn, Inservice and Implementation Consultant, Curriculum Branch. Phone 427-2984 or fax 422-3745.

Appendix F

Alberta
EDUCATION

MEMORANDUM

FROM: Bev Romanyshyn
Inservice and Implementation Consultant
Curriculum Branch

TO:

DATE: June 6, 1991

TELEPHONE: 427-2984

FAX: 422-3745

SUBJECT: **SCIENCE 10 INSERVICE SESSIONS**

You are now officially registered for the Science 10 inservice activities in June and August. Please check the attached printout for accuracy as to accommodation and breakfast arrangements. Lunch, dinner and evening socials will be available for all registered participants. Should there be an error in your booking please notify me as soon as possible.

Parking is available in various lots around the area at $6.00 per day or an hourly rate. If you are coming to Lister Hall Sunday evening, June 23, please register at the desk inside the main entrance. Parking is available in Lot T behind Lister Hall.

The revised inservice schedule and a map of the Education Building, second floor is enclosed. Registration packages will be distributed outside room N2-115, Education Building, University of Alberta between 7:30 and 8:30 a.m., June 24. The first plenary session will be held in room N2-115 beginning at 8:30 a.m. Coffee and refreshments will be available for breaks throughout the three-day inservice in this area. Kiva, Rm Ed N2-103, a circular room next to room N2-115 will be the location of display booths for various resource agencies such as Alberta Environment, Alberta Agriculture and Alberta Energy.

You will be provided with a personal journal in your registration package for recording your initial perceptions before the various workshops begin as well as perceptions after each of the six workshops. These reflections will be extremely useful in determining the effectiveness of the workshops and in the planning for the August sessions. The journals will be collected for analysis at the end of the session.

A detailed equipment list for Science 10, Unit 1 and 2, based on the draft basic resource is enclosed. The Units 3 and 4 list will be included in your registration package. Geranium maintenance and propogation information as well as aquarium maintenance information will also be included in your registration package.

The draft Science 10 basic resource will be provided to you at the inservice. The accompanying teacher's guide will be available at the August session. Currently, the draft basic resource; Units 3 and 4, are in the final stages of revision. The first draft of the Senior High Science Teacher Resource Manual, the Science 10 Teacher Resource Manual and a teacher supplement for Science 10 will all be supplied to you.

.../2

I would encourage all participants and particularly the Edmonton and area folks to stay for the dinners and socials, taking the opportunity to mix with the other participants. The Honourable Jim Dinning, Minister of Education will attend the barbecue on Tuesday evening, June 25. We are planning meals and hospitality for all participants unless otherwise indicated. If you are definitely unable to attend a dinner or social please notify Mary Ann Bivol at 427-2984 or let her know by fax at 422-3745. If we are not notified that you will not attend the dinners or evening socials we will assume you will be present and plan accordingly.

Jurisdiction personnel and other agency representatives will have their food and accomodation fees (approximately $65 per day) charged back to their organizations. Workshop presenters will have their costs covered by Alberta Education.

Should you have any questions or concerns regarding the inservice please call me.

Bev Romanyshyn

Bev Romanyshyn

Enclosures

Science 10 Inservice Schedule
Alberta Education/Department Of Secondary Education
June 24, 25, 26 - 1991

University Of Alberta
Education Building/Lister Hall

Monday, June 24

7:30-8:30	Registration Package Pickup/Outside Rm Ed N2-115
8:30-9:30	Plenary Session/Rm Ed N2-115 Welcome and Introductions - Morris Treasure/Raja Panwar Announcements/Personal Journal Writing - Bev Romanyshyn Perceptions of the New Science Programs - Jim McConnell and a mystery guest
9:30-12:30	Workshops (1-5)
12:45-2:00	Lunch - Lister Hall, Large Banquet Room
2:00-5:00	Workshops (1-5)
5:00-5:45	Resource Agency Reps/Displays Available/Kiva - Adjacent Rm Ed N2-115
6:00-9:30	Dinner and Social/Lister Hall - Large Banquet Room

Tuesday, June 25

8:30-9:30	Plenary Session/Rm Ed N2-115 Gage Publishers/Science 10 Teachers Guide David Blades
9:30-12:30	Workshops (1-5)
12:30-1:45	Picnic Bag Lunch/Outside Education Bldg.
2:00-5:00	Workshops (1-5)
5:00-5:45	Resource Agency Reps/Displays available/Kiva - adjacent Ed N2-115
6:00-9:30	Barbecue and Social University House - N.W. Corner of Campus

Wednesday, June 26

8:30-9:30	Plenary Session/Rm Ed N2-115 Energy/Matter/Change Science 10 Teacher Background Bev Yee and Bob Ritter
9:30-12:30	Workshops (1-5)

CB 91 06 04 (RW Sci-Inservice/June)

12:30-2:00	Buffet Lunch/Faculty Club - N.W. Corner of Campus
2:30-3:30	Plenary Session/Rm Ed N2-115 Wrap-up comments/Announcements Personal Journal Submission Expense Claim Forms (mileage and parking)

WORKSHOPS

- five concurrent sessions
- approximately 35 participants per session
- workshop groups and room numbers will be indicated in your registration package

Coffee breaks will be provided in all 3-hour workshops. Refreshments will be available outside Room Ed N2-115.

Workshop Topics and Facilitators

1. Teaching for Thinking in Science
   - David Blades
2. STS Teaching Strategies
   - Bob Ritter
3. Focus on Research
   - Gloria Hodgetts
   - Jeff Goldie
4. Technology and Media in the Science Classroom
   - Desiree Hackman
   - John Marean
   - Don Tronsgard
5. Evaluation and Assessment
   - Tammy Conacher
   - Yvonne Johnston
   - Terry Grier

CB 91 06 04 (RW Sci-Inservice/June)

SCIENCE 10 - JUNE INSERVICE SESSION

Workshop Rotation Schedule

Workshop Title and Room	M 9:30-12:30	M 2:00-5:00	T 9:30-12:30	T 2:00-5:00	W 9:30-12:30
Media & Technology Ed 213 (Laserdisc)	Red **A**	Purple **A**	Pink **A**	Yellow **A**	Blue **A**
Media & Technology Ed 155 (Apple Lab)	Red **B**	Purple **B**	Pink **B**	Yellow **B**	Blue **B**
Media & Technology Ed N3-110 (IBM Lab)	Red **C**	Purple **C**	Pink **C**	Yellow **C**	Blue **C**
Teaching for Thinking Ed 262	Blue	Red	Purple	Pink	Yellow
Focus on Research ED 265	Yellow	Blue	Red	Purple	Pink
STS Strategies Ed 359	Pink	Yellow	Blue	Red	Purple
STS Evaluation & Assessment Ed 358	Purple	Pink	Yellow	Blue	Red

The "Media & Technology" workshop is divided into three sections – A, B and C. Please go to the room matching the section letter on your nametag. You will circulate through all three sections in the three-hour time period.

All other sessions are within the one designated room.

Alberta MEMORANDUM
EDUCATION

FROM: Bev Romanyshyn
Inservice Implementation Consultant
Curriculum Branch

OUR FILE REFERENCE: Ins/v2

YOUR FILE REFERENCE:

TO: Pam Shipstone
Learning Resource Consultant
Curriculum Branch
Box 17

DATE: August 16, 1991

TELEPHONE: 427-2984

SUBJECT: **SCIENCE 10 INSERVICE AUGUST 29 AND 30, 1991**

Please find on the following page the revised agenda for the August 29 and 30 inservice sessions.

Coffee and muffins will be set up outside Ed N2-115, August 29 and 30 by 7:45 a.m.

Registration packages and August draft Gage texts will be available for pickup from 8:00 a.m. outside Ed N2-115.

Two one hour plenary sessions (Science 10 overview/text and evaluation and assessment) will provide a framework for the unit workshops which follow.

Accommodation and meals have been arranged with the University of Alberta, Conference Services, as per your registration forms previously submitted in May. If changes are required please call me at 427-2984 to make arrangements before August 23.

Participants are requested to bring their Science 10 Course of Studies (goldenrod), TRM and their Science 10 TRM which were distributed in June for use in the unit planning sessions.

You will not require the June draft of the Science 10 Gage text as an August draft will be provided to you.

Dress is again informal and there is no lunch at the Faculty Club planned for this session.

The Barbeque, August 29 at University House will have a cash bar social beginning at 5:30 p.m. Non-alcoholic beverages will be available free of charge. The facility and "munchies" are courtesy of Gage Educational Publishing Company.

Bev Romanyshyn
Bev Romanyshyn

BR/mab
Enclosure

SCIENCE 10 FIELD TEST INSERVICE

SESSION 2 - AUGUST 29, 30 1991

Alberta Education
Department of Secondary Education
Education Building
University of Alberta
Edmonton, Alberta

Thursday, August 29

8:00 - 8:30	Registration Package Pickup/Outside Ed N2-115 August Draft Text/Teacher's Guide distributed	
8:30 - 9:00	Plenary Session - Ed N2-115 Welcome and Announcements	- Bev Romanyshyn
	Evaluation and Assessment in Science 10	- Raja Panwar - Yvonne Johnson - Desiree Hackman
9:00 - 12:00	Workshops (1-4)	
12:00 - 1:30	Picnic Luncheon - Plates distributed outside Rm Ed N2-115	
1:30 - 4:30	Workshops (1-4)	
5:30 - 9:30	B-B-Q and Social - University House	

Friday, August 30

8:30 - 11:30	Workshops (1-4)
11:30 - 12:30	Picnic Bag Lunch - distributed outside Rm Ed N2-115 Expense forms available and collected in Rm Ed N2-115
12:30 - 3:30	Workshops (1-4)

Workshops 1-4

Four concurrent sessions on Science 10 unit planning and activities.
Ten activities from each unit set-up.
Approximately 40 persons per session will be split into two groups of 20 each.

Workshop	Room	Facilitators
Unit 1	Ed 314	**Karen Slevinsky**, **Daryl Chichak**, Oliver Lantz, Lowell Hackman
Unit 2	Ed 358	**Bob Ritter**, **Karen Hobbs**, George Cormie, Rod McDonald
Unit 3	Ed 326	**Debra MacArthur**, **Gayle Gislason**, Stella Shrum, Dave Margach
Unit 4	Ed 359	**Bev Yee**, **Craig Emter**, Bob Holzer, Wytze Brouwer

WORKSHOP OUTLINE

SCIENCE 10 FIELD TEST INSERVICE

Session 2 - August 29, 30 - 1991

Time: 3 Hours

Group Size: Approximately 40 Split into two sections (A & B) of 20

Section A

Sample Activities (85 min.)

- 10 groups of 2 persons each
- 10 stations/5 with evaluation criteria
- Introduction (5 min)
  (teacher facilitator)
- Activity Station Survey (20 min)
  - 2 minutes at each station
- Activity done in Depth (1 per group - 30 min)
  - do activity as student would
  - provide ideas for alternatives (activity, equipment, substitutions) on sheets provided
  - provide a specific evaluation instrument or critique and improve evaluation instrument on sheets provided
- Report Back to Group (30 min.)
- Collect suggestion sheets for duplication and future distribution

Section B

Unit Planning (85 min.)

- 5 groups of 4 persons each

Introduction (15 min)
Alta Ed Program Consultant

- Energy - Matter - Change
- Interdisciplinary Nature of Unit
- STS Connections
- Flexibility in Unit Flow

Unit Planning Intro (5 min)
Teacher Facilitator

- Group Planning (65 min):
  Unit flow (order of concepts)
  Time allocation (periods/blocks)
  Selection of Activities
  Materials Required
  Evaluation Strategies (65 min)
  Support Resources Identification
- Collect Unit Plan Forms for duplication and distribution

Section A & B Switch After 85 Minutes

Journal Writing - Last 10 minutes of last section.

Coffee Available Outside Rooms

CB 91 07 04 (MB Bev-Misc. Outline)

SCIENCE 10 INSERVICE

UNIVERSITY OF ALBERTA

AUGUST 29 & 30, 1991

FACILITATOR'S NOTES
from Bev Romanyshyn

- All inservice participants will receive the following documents with their registration packages:
    - Agenda for August 29 and 30, 1991
    - Rotation Schedule for Workshops
    - Visions 1 textbook (field validation draft)
    - Teacher's guide to accompany the Visions 1 textbook (field validation draft)
    - Updated "Resource" sections for the Senior High Science Teacher Resource Manual (TRM) and the Science 10 Teacher Resource Manual (TRM)
- It is expected that participants will bring their TRMs with them. Five backup copies of each TRM will be provided to the Unit Workshop facilitator. The sections particularly useful in preliminary Unit Planning Workshops are:

Senior High Science TRM

Section 3A	Teaching for Thinking in the Science Classroom
Section 3F	Language for Thinking and Communication
Section 3G	Effective Use of a Research Process
Section 3I	An STS Context for Science Learning
Section 3J	Controversial Issues in the Classroom
Section 3K	Thematic Approach in Science
Section 4	Preparation and Planning
Section 5	Student Evaluation and Assessment (sample instruments)
Section 6	Resources (update)

.../2

Science 10 TRM

Section 2	Science 10 Course of Studies, by Unit Sample Lessons, by Unit
Section 3	Course Evaluation and Assessment (Unit 1 sample assignments)
Section 4	Library Research in Science (suggestions for research projects)
Section 5	Resources (update)

- The Science 10 Course of Studies is included (in segments) within the Science 10 TRM, thus eliminating the need for a separate Science 10 course of studies.

- Evaluation and assessment will be dealt with in a general way in the introductory plenary session, to provide a suggested framework for Science 10 and assurance that the diploma examinations in all new senior high science courses will change to reflect the new curriculum. Field test teachers' input will be actively sought to provide samples of portfolios, unit exams, items for the testbank, and evaluation instruments.

- Each colour group (red, purple, blue, yellow) of 40 participants will be divided into two sections, A and B. One section begins with activities (ideal) and the other with unit planning. Session 1 and 3, the A sections, begin with activities, while in sessions 2 and 4 the B sections, begin with the activities.

Unit Planning Section (85 min)

- The Alberta Education program consultant in each unit planning section will provide concrete examples of how the energy, matter and change themes, the interdisciplinary nature, STS connections and flexibility, in order of coverage, play out in that particular unit (15 minutes).

- The teacher facilitator will take over for the remaining time in the unit planning section (70 minutes).

- A form providing a structure for unit planning will be provided for each group (sample attached).

- Coffee will be setup outside the room and available for teachers throughout the unit planning sessions. Coffee should not be taken into the Activity Section of the workshop.

- Unit plans will be collected and duplicated Thursday for distribution on Friday. Friday's unit plans will be collected, duplicated and distributed the following week.

.../3

Activities Section (85 min)

- The teacher facilitator will guide participants, as indicated on the workshop outline, encouraging maximum participation through reporting of ideas and evaluation strategies on sheets that will be provided. Collection of the sheets after each section is very important as these ideas will be processed, duplicated and sent to all field test teachers.
- The teacher facilitator is expected to develop evaluation criteria (instruments) for five of the ten activities. Many samples, which can be easily adapted, are provided in the Senior High Science TRM (Evaluation and Assessment Section) and in the Science 14–24 TRM.

Journal Writing

- Journal writing is a most important component of each workshop. It is to be done in the final 10 minutes of the last section of each workshop; the teacher facilitator of the activities and unit planning sections initiates and carries through this activity. All facilitators are expected to model through participation, actively writing their journals during this time. Your reflections on the workshop can be recorded rather than completing the stems provided.
- In the final section of the last session on Friday afternoon please collect all journals – complete and clipped for consideration by Alberta Education. Those will be returned and continued in the fall call back sessions to be held in each Zone.
- All facilitators are expected to model teaching strategies appropriate to the new science programs – promoting thinking and active participation, facilitating STS connections, encouraging cooperative learning, broader evaluation and assessment strategies.

Preparation and Planning Meeting

- **The final planning and preparation meeting of all facilitators will be held August 28, 9:00 a.m. to 12:00 noon in the University of Alberta, Education Building, Room 358. The afternoon, 1:00 p.m. to 4:00 p.m., will be for unit workshop set-up of activities and unit planning rooms.**

I will be on holidays from July 8 to July 26, returning to work Monday, July 29. I am eager to discuss any aspect of these workshops with you from July 29 on. The activity kits will be assembled in early August. Final activity lists and the field test draft of the textbook will be provided to you as soon as possible in August.

I am looking forward to working with all of you on this project. Have a super summer!

Bev Romanyshyn

Business phone: 427-2984

Fax: 422-3745

Home phone: 455-0121

CB 91 07 05 (RW Sci/Inservice-Facilitators Notes)

Alberta
EDUCATION

FROM: Bev Romanyshyn
Inservice Implementation Consultant
Curriculum Branch

TO: Raja Panwar
Program Manager, Secondary Science
Curriculum Branch

OUR FILE REFERENCE: Phase 2
YOUR FILE REFERENCE:
DATE: May 28, 1992
TELEPHONE: 427-2984
FAX: 422-3745

SUBJECT: **PHASE 2 SENIOR HIGH SCIENCE FIELD VALIDATION PROJECT**

Welcome to the Phase 2 of the Senior High Science Field Validation Project. You have been registered as a participant at the 20-level science inservice, June 21-25 at the University of Lethbridge. Approximately 130 teachers will be involved in these inservice activities along with jurisdiction curriculum representatives and Alberta Education personnel.

A kickoff barbeque is planned for 7:30 p.m. Sunday evening at the University of Lethbridge. Inservice activities will conclude at noon on Thursday, allowing adequate travel time to assure teachers are back in their schools Friday morning.

Cindy Lavallee, Conference Services Director at the University of Lethbridge, will be contacting you in the near future regarding accommodation and meal package options available to you. Should you wish a seat on the chartered bus which will leave Edmonton Sunday, June 21 in the early afternoon and return June 25 at lunch time please let me know.

The *Agenda Information and Planning Sheet* attached provides you with the basic schedule for the four inservice days.

Inservice activities on all four mornings begin with a one-hour plenary session. Following these plenary sessions designated groups of participants will rotate through each of four, 2 1/2-hour sessions (one per day) where representative activities from science 20 and the 20-level discipline courses will be setup. The Curriculum Branch program consultants will facilitate these sessions which provide for hands-on experience, assessment and evaluation suggestions and discussion. For example, the Unit 2, Science 20 activity session may crossover with Biology 20 as well as include some which are unique and different in the Biology 20 course.

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In the afternoons and evenings a full range of activity choices will be available to you. Use the *Workshop Information Sheet* included to select from the variety of workshops available. Complete the *Agenda Information and Planning Sheet* and return it to me before ~~May~~ June 1 —— by fax (422-3745). As far as possible your choices will be accommodated in your finalized schedule. Your finalized schedule for afternoons and evenings will be included in your registration package. Should you have any questions please call me at 427-2984.

Bev Romanyshyn
Bev Romanyshyn

BR/mab
Enclosures

c.c. Lloyd Symyrozum, Director

Agenda Information and Planning Sheet

Field Validation Teacher Inservice

June 21, 22, 23, 24, 25 – University of Lethbridge

Teacher Name:____________________________

School:____________________________

I will teach in 1992–93:

☐Sci 20 ☐Bio 20 ☐Chem 20 ☐Phys 20

	Monday	Tuesday	Wednesday	Thursday
8:30 – 9:30	Plenary	Plenary	Plenary	Plenary
9:30 – 12:00	Unit 1 – Science 20	Unit 2 – Science 20	Unit 3 – Science 20	Unit 4 – Science 20
Sample Activities		Biology 20	Chemistry 20	Physics 20
		Lunch		
1:00 – 4:00 Possible 3-hour Workshops: Indicate Choice 1 and Choice 2 for each afternoon in left column	☐ Aquatic Ecosystem Study	☐ Terrestrial Ecosystem Study	☐ Water/ Waste Water Treatment	
	☐ Cooperative Learning	☐ Geology	☐ Biophysics	
	☐ Environmental Connections	☐ Unified Approach to Science 20	☐ Global Warming	
	☐ Technology in the Science Classroom	☐ Planning for Student Assessment and Evaluation	☐ Minimizing Chemical Waste in Science Classrooms	
	☐ Archeology/ Paleontology	☐ Science in Police Work	☐ Science in Police Work	
4:00 – 6:00 Check times you prefer to attend	☐ Planning Rooms/Support Resource Previewing	☐ Planning Rooms/Support Resource Previewing	☐ Planning Rooms/Support Resource Previewing	
	☐ Publishers' Displays	☐ Publishers' Displays	☐ Publishers' Displays	
		Dinner		
7:30 – 9:00 Check times you prefer to attend	☐ Planning Rooms/Support Resource Previewing	☐ Planning Rooms/Support Resource Previewing	☐ Planning Rooms/Support Resource Previewing	
	☐ Publishers' Displays	☐ Publishers' Displays	☐ Publishers' Displays	

NOTE:

Annotations for each workshop are provided on the "Workshop Information Sheet" to help you make your choices.

NOTE:

You may attend either of these two activities more than once.

CB: 1992 05 20 (Draft)

WORKSHOP INFORMATION SHEET

Making Choices

The topics of the 15 workshops being offered on the three inservice afternoons were determined by a process of consultation with the field validation teachers, a polling of these teachers and the availability of workshop leaders. Although each of these topics is seen to provide useful background to one or more 20-level science courses, often the background provided will be applicable to Science 10 and/or a combination of the 30-level science courses as well. Some workshops will provide very explicit curriculum links while others will require teachers to determine the curricular fit of the background provided before applying to classroom practice.

In each 1:00–4:00 p.m. time period, on each of the three afternoons, teachers can choose any one of the five workshops described on the next page. Each workshop will be approximately three hours in length. We request that you indicate both a first and second choice for each afternoon on your *Agenda Information and Planning Sheet*. The workshop on "Science in Police Work" will be offered on Tuesday and repeated on Wednesday as large numbers of teachers had expressed interest in this topic.

In the 4:00–6:00 p.m. and the 7:30–9:00 p.m. time periods on each of the three days, teacher planning rooms and an Alberta Education viewing room of support resources including print, AV and computer applications will be available if demand warrants. Publishers whose resources are being field validated have been invited to set up displays and to meet with you in these same time periods. You may check off more than one time to visit the planning rooms/resource previewing rooms or the publishers' displays. The indication of the time you will visit on your *Agenda Information Planning Sheet* will help us determine which of these several time periods will be required to accommodate all inservice participants.

Workshop Descriptions

Monday P.M. Choices

Aquatic Ecosystem Study

Workshop Leaders: *The Aquatic Invertebrate Monitoring Program – AIM*
Jane Dyke, Ross Sheppard High School
Bev Yee, Alberta Environment
Ann-Marie Anderson, Alberta Environment
Research on Salmon Behaviour
Dr. Lincoln Chew, Department of Psychology, University of Lethbridge

Learn how to arrange and lead a field study of a freshwater stream or river by participating in such a field trip. AIM is a water quality monitoring program for high school biology students that has an excellent fit for the new Science 30 course. The program provides students an opportunity to duplicate the work of aquatic biologists and to make informed decisions regarding society's use of water. The workshop will include an overview of the available resources (teacher resource binder, video, poster, and identification keys) as well as field sampling and laboratory identification of invertebrates. Dr. Lincoln Chew will follow up the AIM segment of this workshop by discussing his research into the effects of the environment on the behaviour of salmon. A tour of his research laboratory will be provided. This workshop will likely continue until 5:00 p.m. (4 hours)

Cooperative Learning

Workshop Leaders: Pat Adams and Don Johnson
Strathcona Tweedsmuir School, Okotoks

"Cooperative Learning is the Ultimate Tool to Encourage Effective Independent Learning."

This session will focus on the use of 3 or 4 different cooperative learning strategies and their application to the Science 20 curriculum. Specific lessons will be presented to demonstrate how these methodologies can be applied to laboratory experience, test preparation and knowledge acquisition. Although the focus will be on Science 20, cooperative learning methodologies have application to the 20-level disciplines as well.

Environmental Connections

Workshop Leaders: Joe Prusak
Alberta Environment

There are many opportunities in the new 20-level science course to use environmental issues as an STS context for learning. Alberta Environment provides high school teachers with a variety of environmental education materials that will complement specific components within the science curriculum. This presentation will include a brief description of these materials and will outline how they can be used to meet specific objectives as outlined in the Science 10-20-30 curriculum. Topics to be addressed will include air quality, pesticides, waste management and water quality. Specific attention will be given to Alberta Environment's Acidic Deposition unit and its relevance to the Science 30 curriculum. Investigate how you might use these opportunities in your classroom.

Technology in the Science Classroom

Workshop Leaders: Wilf Kazamaier, John Diefenbaker High School
Bob McRae, Bonnyville Composite High School

Teachers are invited to expand their knowledge and skills in the area of laserdiscs and science laboratory interfaces. Opportunities for hands-on experience and discussion of these applications with two teachers who use these technologies in their classrooms will be provided. This workshop will have two sections, 1 1/2 hours each. One, led by Wilf, will feature laserdiscs. The other section, led by Bob, will focus on the Champ II science interface system.

Archeology/Paleontology

Workshop Leaders: Dr. Margaret Kennedy, University of Lethbridge
Sid Andrews, Science Alberta Foundation/Tyrrell Museum

Background to these two areas will be useful when teaching Science 20, Unit 1, "The Changing Earth". Dr. Margaret Kennedy will define archeology and explain some archeological techniques. Case studies and hands-on activities may be part of this presentation. Sid Andrews will provide suitable paleontological background for Unit 1 based on his experience with the Tyrrell Museum.

Tuesday P.M. Choices

Terrestrial Ecosystem Study

Workshop Leader: Jane Dyke, Ross Sheppard High School
Assistants: Bill Sharp, Department of Biology (ecologist), University of Lethbridge
George Cormie, Biology 20-30 Program Consultant

This workshop will provide you with a general framework for the organization and implementation of a terrestrial ecosystem study with your Science 20 or Biology 20 class, regardless of where your school is located. You will have opportunities to practise the required field techniques in the southern Alberta ecosystem setting. Monitoring of abiotic factors and the collecting/counting techniques for living organisms will be covered in detail. Suggestions as to how to challenge students to analyze and synthesize within the framework of the terrestrial ecosystem study will be provided.

Geology

Workshop Leader: Geologist (to be confirmed)

Composition of the Earth, the theory of Plate Tectonics, earthquakes, volcanoes and glaciation – all topics covered in Science 20, Unit 1. Join this workshop for simple and concise coverage of the major concepts required to teach this unit.

Unified Approach to Science 20

Workshop Leader: David Blades, College of Education, University of Saskatchewan

This workshop presents a challenge for the brave, temptation for the curious, and an opportunity for the bored. Abandon the traditional boundaries of science disciplines and develop with colleagues practical plans for unifying the topics in Science 20 around locally developed, relevant themes. This workshop is not for the faint of heart. Introducing a unified science course requires a commitment to becoming a teacher–researcher and a strong desire to try something different in science education. Workshop participants will examine examples of successful unified science programs, discuss the features of a good unified science course, and develop course outlines in groups for a unified Science 20 that could be introduced in September, 1992.

Planning for Student Assessment and Evaluation

Workshop Leaders: Phill Campbell, Assistant Director, Student Evaluation
Lowell Hackman, Examination Manager, Biology 30
Don Loerke, Examination Manager, Chemistry 30

Student assessment strategies should encompass the broad range of course objectives classified as knowledge, skills and attitudes. Three subgroups will be formed to consider how these objectives can be assessed. Various examples of how to assess these objectives will be provided for consideration. A concluding plenary session will address the incorporation of the identified assessment strategies into an evaluation plan for the course. Participants will leave the session with a framework that will assist them in their evaluation of students.

Science In Police Work

Workshop Leader: Corporal Ted Emmanuels, Traffic Analyst, RCMP, Peace River

This workshop will look at this high interest application of science principles to investigative police work. Accident investigation will be prominently featured and the workshop will provide excellent background for a motivating teaching context, particularly in the Physics area.

Wednesday P.M. Choices

Water/Waste Water Treatment

Workshop Leader: Doug Coupp, Waste Water Treatment Plant, Supervisor (to be confirmed)
Gordon Mose, Water Treatment Plant, P.Eng (to be confirmed)

A tour of the water treatment plant and the waste water treatment plant in Lethbridge will be coupled with opportunities to discuss with experts the science detail of these processes. The workshop provides background related to Science 20, Unit 3, and Chemistry 20, Unit 2, and Science 30, Unit 2.

Biophysics

Workshop Leader: Dr. D.J. Siminovitch, Department of Physics, University of Lethbridge

Although the origins of biophysics date back to antiquity, the field of biophysics has rapidly developed and matured just in the quarter century following World War II. As will be discussed, the pace and scope of this development provide many excellent examples of the interconnections among science, technology and society. New discoveries and advances in this field have often relied on the development of new mathematical and physical methods, of which the technique of nuclear magnetic resonance is a prime example. Beginning as a somewhat esoteric physical technique just after the Second World War, NMR (MRI) has blossomed in the subsequent five decades to become an exceedingly powerful and elegant spectroscopic tool, with wide-ranging applications in physics, chemistry, biology, materials science and medicine. Some of the more interesting of these applications will be discussed in the context of connections among science, technology and society. The workshop will conclude with a nuts-and-bolts session in the laboratory, where an NMR (MRI) spectrometer is being assembled. This workshop will provide background for teaching sections of Chemistry 20-30, Biology 20-30, Physics 20-30 and Science 30.

NMR = Nuclear Magnetic Resonance
MRI = Magnetic Resonance Imaging

Global Warming

Workshop Leader: Dr. Jim Byrne, Department of Geography, University of Lethbridge

Global warming is an environmental issue that appears in several senior high science courses. Join this group for useful background on this issue. Jim Byrne will explore global warming with you through discussion and an illustrated slide presentation. His own research on the impacts of global warming on water resources will be addressed in this session.

Minimizing Chemical Waste in Science Classrooms

Workshop Leader: Dr. Margaret Ann Armour, Assistant Chair, Department of Chemistry
University of Alberta

Discussion of micro-scale chemistry and other waste minimization strategies coupled with hands-on practise in waste treatment will be the focus of this workshop. The Science 20, Chemistry 20 and Biology 20 courses will provide the context for this workshop so the strategies and techniques addressed are directly transferable to your classroom practise.

Science and Police Work (repeat session)

*See Tuesday's workshop description.

Late Afternoon/Evening Choices, Monday, Tuesday or Wednesday

Planning Rooms/Support Resource Previewing

Various areas will be made available for teachers who wish to plan either individually or cooperatively. The support resource previewing room will be set up nearby and will be facilitated by Pamela Shipstone, who is assembling a variety of excellent books, posters, packages, videos and laserdiscs for preview. Make sure you stop in and sample what is available.

Publishers' Displays

Publishers of the 20-30 level field validation student texts and their supporting material(s) will be setting up displays of their resources for your consideration. Representatives will be available to answer your questions. The following publishers have agreed to participate.

John Wiley & Sons Canada Ltd.
Nelson Canada
Maxwell MacMillan Canada

Addison-Wesley Publishers Limited
D.C. Heath
Gage Educational Publishing

Important Information!

Name Tags

Your name tag is extremely important as the coloured dot indicates your morning activity session group and the holder contains your meal ticket. Please wear your name tag at all times

Personal Journals

Your journal has been put together to reflect the afternoon workshops you have been registered in. Please take the time to provide feedback to us on all activities you participate in over the next four days. Journals will be collected at the last plenary session on Thursday. If you are leaving early please give your journal to Bev Romanyshyn before you depart.

Teacher Recognition Certificates

20-Level field validation teachers will be presented with certificates in the Thursday plenary session. If you are leaving early please see Bev and she will arrange to give you your certificate early.

Field Trips

Priddis Observatory, Energeum and Geology-all day.

All field trip buses will depart and return to parking lot P21 near the Earth Sciences Building. Four buses will be available for the Wednesday field trip to accommodate approximately 175 participants. Packed lunches and refreshments will be provided during the day and we will return in time for dinner, approximately 5:30 PM.

Meals

All meals are to be picked up in the Alberta Room of the Dining Centre.(cafeteria style) We have the adjacent "Blue Room" reserved so all inservice participants can eat together in stead of in the Alberta Room which is the common dining hall. The exception is lunch on Tuesday when the Blue Room is unavailable and we will eat in the Alberta Room.

Visit Room SB 142

Alberta Education Resource Room
Weather Satellite Data and Science 10/20/30 - Bob Sheppard

Pam Shipstone will have a display of support resources for Senior High Science courses available in Room SB 142 on both Monday and Tuesday afternoon (4:30 - 5:45 PM) and evening(7:00 -8:30PM). Bob Sheppard will be available in the same room to demonstrate and discuss how schools in the Calgary Public system have used satellite weather monitoring to support the new science curriculum.

Publishers Displays

The publishers of the basic textbooks for Biology 20-30, Chemistry 20-30 and Physics 20-30 will have displays set up along the wall of the Alberta Room in the Dining Centre.on Monday and Tuesday Please visit these displays and find out the details of the various teacher support materials each publisher has to offer. We thank the publishers for their participation.

Swap Shop Masters/TRM Masters

Would the contact teacher from each school please see Bev before or after any plenary session to collect your schools package of master for the materials submitted to date for the swap shop and masters of the four TRM's. Swap shop materials will continue to be accepted at the inservice or any time over the summer and will be duplicated for distribution to schools in the fall. The response so far has been good and we hope more materials will be submitted in the next few weeks.

Eco-Regions of Alberta Poster

Alberta Fish and Wildlife have kindly provided a poster for each classroom teacher in attendance. These posters were recommended by the Dr. Len Hills of the University of Calgary, Department of Geology and Geophysics, as excellent support material for the all day field trip he and his colleagues have organized for us. You will receive one during the inservice activities.

**If you have any questions or concerns regarding any aspect of the inservice please talk to Bev Romanyshyn .*

Fax 422-3745

April 27, 1993

«teacher»
«IF school»«school»
«ENDIF»«IF street»«street»
«ENDIF»«IF street2»«street2»
«ENDIF»«city», «prov»
«pc»

Dear «sal»:

The validation of the new 20-level science courses is proceeding smoothly. On behalf of the science team I wish to express our continuing appreciation for the hard work and cooperation your science teacher(s) have demonstrated throughout this project, and for your continuing support of our efforts.

I have included the following documents for your information. Please feel free to copy and circulate them among your science and counselling staff members. The Science Team welcomes your comments or questions, and would be pleased to discuss issues arising from the *Senior High Science Program Development and Validation Report* and the enclosed documents. I am especially interested in finding out whether we are providing you with the information you need in a timely manner.

Senior High Science Program Development and Validation Report
Provides a synopsis of the 20-level field validation project, and revisions to the courses of study to date as well as an update on several other science related projects.

The New Senior High Science Programs: Answering the Common Concerns
Identifies and answers the most common questions asked by teachers and administrators during the March information sessions on the new 20-level science courses.

Science 30 and the Admission Requirements for Post-Secondary Institutions
Summarizes the admission requirements, related to Science 30 for the University of Alberta, University of Calgary, University of Lethbridge, NAIT and SAIT. It is hoped this draft document will be useful to administrators, counsellors and teachers as they help Science 10 students to make informed decisions regarding their 20-level science course selection.

Secondary Science Resources
An updated listing of Alberta Education authorized or produced print and video resources available to support the new secondary science programs.

Provincial Senior High Science Information Sessions Complete

In March the Curriculum Branch Science Team, ably assisted by several field validation teachers, presented eight day long information sessions on the new 20-level courses. Over 700 teachers attended these sessions. The leadership of the following field validation teachers added the important "voice of the classroom teacher" to the proceedings. A special thank you to the following teachers who provided strong leadership in these sessions:

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March 5	Calgary	Virginia Lo Pinto - John G. Diefenbaker High - Calgary
March 12	Grande Prairie	Lawerence Boyko - Central Peace High Spirit River
March 15	Red Deer	Rosa Andreiuk - Central High - Sedgewick
March 16	Lethbridge	Dixie Hedley - Lethbridge Collegiate Institute
March 17	Airdrie	Dale Hobbs, Gord Sellin, Rick Smith - George McDougall High School - Airdrie
March 25	Edmonton	Pauletta Renkema - Lorne Jenken High School - Barrhead
March 26	Edmonton	Desiree Hackman - Sturgeon Composite High School - Namao

Teleconferences

Our next series of teleconferences is to be held during May 18–20, 1993. If you wish to sit in on the teleconferences and participate in or listen to the discussion, please get in touch with the contact teacher in your school for specific dates and time. Teleconferences are an important means of communication and the discussion helps resolve emerging issues, answer questions, and help us shape the program. We look forward to hearing from your contact teacher on the next scheduled teleconference series.

The 30-level Sciences Inservice Session

This inservice will be held June 20 through June 24 at the University of Calgary. The Faculty of Science is working with the science team to plan interdisciplinary background sessions and an interdisciplinary field trip for the teachers. The inservice schedule will reflect the emphasis on assessment and evaluation. This inservice session will provide teachers with a complete picture of the new science programs and will be helpful when planning the delivery of the 10- or the 20-level courses to students in your school. For this reason, all field validation teachers are encouraged to participate in the inservice as they would benefit enormously from the planned sessions, whether they are teaching a 30-level science next school year or not.

On April 20, 1993, Bev Romanyshyn requested the preliminary registration of your field validation teachers and an indication of which 30-level courses they may be teaching, starting in September, 1993. As in the past, Alberta Education will cover costs of accommodation, food, travel and substitute teachers. Specific information on workshops and sessions we plan to offer, and transportation will be provided in early May, 1993. We look forward to working with your science teachers at the June inservice.

Yours sincerely,

Raja Panwar
Program Manager, Secondary Science
Curriculum Branch

RP/tp

Enclosure

Agenda Planning Sheet

Field Validation: Teacher Inservice

June 20, 21, 22, 23 and 24 – University of Calgary

Teacher Name:____________________________

School:____________________________

I will teach in 1993–94:

☐ Sci 30 ☐ Bio 30 ☐ Chem 30 ☐ Phys 30 N/A ☐

		Monday (June 21)		Tuesday (June 22)	Wednesday (June 23)	Thursday (June 24)
8:30 – 9:30 a.m.		Plenary		Plenary	Plenary and Video *Birth of the Rockies*	Plenary
9:30 – 12:00 a.m. Sample Activities		30–Level Activities Session 1		30–Level Activities Session 2	Full Day Field Trip For All Participants	30–Level Activities Session 3
		Lunch				
1:00 – 4:00 p.m. Possible 3-hour Workshops: Indicate Choice 1 and Choice 2 for each afternoon in left column		Global Structure and Plate Tectonics		Global Structure and Plate Tectonics (Repeat Session)	*The Geology of the Calgary to Spray Lakes Area* Presented by: The Geology Department – University of Calgary • Regional Structural Geology • Relation to Plate Tectonics • Stratigraphy • Fossils • Radiometric Dating • Glacial Geology • Ground Water • Economic Geology – Oil, Gas, Coal – Cement, Sand, Gravel • Natural History • Environmental Issues	NOTE: Annotations for each workshop are provided on the "Workshop Information Sheet" to help you make your choices.
		Math/Science Connections (30-levels)		Science 30 – Unit Practical Lab Exam		
		Video Laserdiscs Technology for 30–Level Sciences		Technology of Eye Surgery Sports Medicine Connections		
		Atmospheric Chemistry/Air Quality Monitoring/PERT		Unified Approach to Science 30		
		Cooperative Learning in 30-level Sciences		*Energeum* Trip		
		Peer Evaluation in the 30-level Classroom		Determining Depth – Science 30 Guidelines		
8:00 – 12:00 p.m.		Priddis Observatory (RAO) and Geology Field Trip		Priddis Observatory (RAO) and Geology Field Trip		

CB: 93 05 14

Notice to all 30-Level Sciences Inservice Participants

Campus Map/"Almost Final Agenda"

Another map of the University of Calgary Campus follows for your reference. The plenary sessions at 8:30-9:30 each morning will be in the **Science Theaters Building**, room **ST 135**. The majority of sessions will be held in the **Science B** building with some sessions held in the **Earth Sciences** building. Food services are in the **Dining Centre** and accommodation is in **Olympus Hall**.

The latest draft of the inservice agenda with most of the room numbers indicated follows. You will notice the areas for the morning inservice activities have yet to be designated as does the laboratory area for the Tuesday PM workshop, "Science 30 - Unit Practical Lab Exam" by Dan Leskiw. The final draft agenda which will include these room numbers will be in your registration packages.

Registration Packages/BBQ

140 people are registered for the Kick-off Steak BBQ on Sunday evening (6:00–8:30 PM.) in the **Blue Patio** area of the **Dining Centre**. Registration packages will be available for pickup at the BBQ. The remaining 40 registrants may pick up their packages on Monday morning before the first plenary session just outside room **ST 135**.

In your registration packages you will find extremely important items. Your name tag is of primary importance and we request you wear them at all times during the sessions. As in previous years the coloured dot on your name tag designates your morning activity session group and as the tags are free hanging and secure we hope to place your meal tickets in the name tag holder as well.

The finalized agenda and a "non-faxed" copy of the campus map is also included in your package. All participants will find a personalized journal in their package which is tailored to the workshops you have been registered in. We appeal to you to provide us with feedback in your journal on all of the sessions you attend. The journals continue to be a valuable tool in the planning of sessions which are responsive to teachers expressed needs.

Chartered Bus out of Edmonton

The chartered bus for northern Alberta teachers leaves the Municipal Airport in Edmonton, Sunday, June 20 at 1:30 PM from the lower level drive through area just across from the main doors. Parking is available in the secure Municipal airport parkade for the various vehicles coming into Edmonton ($30 estimated charge). The bus will arrive at the University of Calgary, Olympus Hall at approximately 5:30 PM, allowing time for room check-in before the BBQ at 6:00 PM. This 47-passenger bus will remain in Calgary for the four days to be used for the various field trip activities - the Priddis Observatory evening trips, the Energeum trip and the all day Geology trip. The bus will leave the University of Calgary campus for the return trip at 12:00 AM, Thursday, June 24 after the morning activity session. The list of registered bus riders follows. Please check the list to assure accuracy and report any inaccuracies to me ASAP.

Parking

If you are bringing a school van or private vehicle and staying in Olympus Hall, parking is available in the Olympus Hall parking lots P48, P49 and P50 at $2.00 per day. For those staying off campus parking can be found in lots P22 ($4.25 per day), Lot P32 ($2.25 per day) or the Art Parkade ($3.25 per day).

Accommodation

The apartment units in Olympus Hall have kitchen facilities with operational refrigerators. Stoves are turned off for the summer and no dishes or kitchen accessories are provided. Bedding, towels and hangers are provided. The building is not air-conditioned but it is apparently very comfortable as an efficient central air circulation system is in operation and bay windows allow for good air flow.

Food Services

The Dining Centre is a pleasant walking distance from the Science B area, an estimated 10-minute stroll. We will extend the lunch period to 1 1/2 hours to allow the walking time and to avoid a "rushed" lunch period. Meal cards will be issued to all participants and, with the exception of the BBQ on Sunday evening, all meals on campus will provide choice in a cafeteria-style setting. Packed lunches will be provided for the Wednesday geology field trip and for those wishing them on Thursday at noon as the inservice ends and you head home.

Swap Shop Masters/TRM Masters

Every effort will be made to have master copies of the swap shop material which has been collected from the various contributing teachers and schools available to contact teachers at the inservice. Any items you have developed for Science 10 or any of the 20-level sciences are most welcome, even if submitted too late for inservice duplication purposed. We will provide master copies of any material received late to your contact teacher in time for school start-up next September. Masters of the latest drafts of the Biology, Chemistry, Physics and Science 20-30 TRMs will also be provided to contact teachers either at the inservice or mailed directly to your school before the end of this school year.

I look forward to seeing you at the inservice and hope the final few days before you leave go relatively smoothly. It certainly is a hectic time of year and we thank you for the extra effort you put in at your school in order to attend the inservice activities.

Activity and Workshop Descriptions
30-Level Sciences Inservice
June 21-24, University of Calgary

Morning 30-Level Activity Sessions

Facititators:
Oliver Lantz - Science 10-20-30 Program Consultant
George Cormie - Biology 20-30 Program Consultant
Stella Shrum - Chemistry 20-30 Program Consultant
Bob Holzer - Physics 20-30 Program Consultant
Dr. Chuck Curry - Biology - U of C
Dr. Liz Dixon - Chemistry - U of C
Dr. David Fry & Dr. Bill Wilson - Physics - U of C
Other representatives from the Faculty of Science working with these professors

As in previous years you will be assigned a particular group (colour) and circulate through laboratory activity sessions. This year there will be only three morning activity sessions rather than four to accommodate the full day field trip on Wednesday, June 23. As far as possible the activites presented to you for practice, consideration, discussion and critique will be applicable to both Science 30 and the complimentary 30-level discipline sciences. The activity sessions are back by popular demand - you told us they are extremely useful and we have considered your suggestions for improvement.of these sessions. Early draft *Visions 3* activities will not be used. Instead appropriate 30-level activities are being chosen and developed by the science team consultants in cooperation with the Faculty of Science representatives from the University of Calgary. We gratefully acknowledge the support and cooperation of the University of Calgary representatives.

Geological Field Trip for All Participants

The Geology of The Calgary to Spray Lakes Area
Wednesday, June 24
10:00 AM-6:00 PM

Facititators: **From the Geology Department, University of Calgary**
Dr. Len Hills, Dr. Alan Oldershaw, Dr. Charles Henderson,
Dr. Jim Brown and John Greggs

Geology by its very nature provides for the integration of principles common to the various discipline sciences. The spectacular topography and geological history of the Calgary west to Spray Lakes area provides the ideal setting for geological learning in the field. It is an opportunity to gather valuable scientific knowledge and STS connection background to bring into your science classrooms. The University of Calgary Geology Department is sponsoring this trip for all participants, an endeavour which requires a tremendous amount of organization, planning and plain hard work. We thank them for their efforts and committed support of science teachers implementing the new science programs.

A background video, "*Birth of the Rockies*" will be shown to all participants before the buses leave the U of C Campus. Background manuals are being prepared and will be available The afternoon session on *Global Structure and Plate Tectonics*, offered on Monday and repeated on Tuesday, provides excellent background for this field trip but is not essential. Hope for a sunny day but prepare for the possiblity of showers and wind.

The purpose of the trip will be to familiarize the participants with the geology of the area. Specifically, the regional structural geology and its relationship to plate tectonics, stratigraphy, fossils, radiometric dating, glacial geology, ground water and economic geology (oil and gas reservoirs, coal, cement, sand and gravel). Additionally, aspects of natural history and environmental issues will be discussed.

Afternoon Workshops

Monday PM Choices

Global Structure and Plate Tectonics
(Session run on Monday and repeated on Tuesday)

Facilitator: Dr. Alan Oldershaw, Geology Department, University of Calgary.

The history of the concept of plate tectonics is an excellent example of how earth scientists think and work and of how an hypothesis can be proposed, discarded, modified and then reinstated (but not necessarily by everyone). Partipants will examine the evolution of an idea, from continental drift through sea floor spreading, to the modern, unifying theory of plate motion and its consequences. Emphasis will be placed on the geological and geophysical methods used to determine the internal structure of the earth, the properties of lithospheric plates and the way in which they move. This session will be presented in a sequence of lectures and laboratory demonstrations. It will provide excellent background for the all day geological field trip on Wednesday, June 23.

Prerequisite: An open and critcial attitude.
Limit: 35 participants

Mathematics/Science Connections (30-levels)
Facilitator: Daryl Chichak, Holy Family School, Edmonton RCSSD

Daryl has recently completed a comprehensive correlation of the secondary mathematics and science curricula and is a strong advocate and practioner of the integration of mathematics and science in classroom practice. Find out how and where the mathematical concepts and skills required for the new 30-level science courses are taught in mathematics? Do you speak the same language and use the same techniques as the mathematics teacher(s)? How can you optimize your students learning by coordinating and cooperating with the mathematics teacher(s)? Can you provide math teachers with appropriate science context problems which would be of mutual benefit? Join Daryl to explore the possibilities. Limit: 35 participants

**The University of Alberta, Centre for Mathematics, Science and Technology Education (CMASTE) is offering a five day summer institute for teachers, August 16-20. The topic will be "Data Mangement and Statistics in the Secondary Science and Mathematics Programs". Graduate Credit or Non-credit participation is possible. Contact Bev Romanyshyn for further details.*

Video Laserdisc Technology for the 30-Level Sciences
Facilitator: Wilf Kazmaier & Gary Raab - Field Validation Teachers
John G. Diefenbaker High School, Calgary

Laser videodiscs provide a rich source of dynamic audio and video information. The ancillary materials for all basic student texts for the senior high discipline science courses include/will include barcodes to provide easy access to laser videodisc resources. This workshop will allow participants to survey these laserdiscs and practise making custom barcode lessons using standard computer technology. The session will be run in a Macintosh computer laboratory.

Limit: 25 participants

Atmospheric Chemistry: Background for Science Teachers
Air Quality Monitoring and Pollution Emergency Response Team

Facilitators: Dr. Karen McDonald, Atmospheric Chemist, Environment Canada - Background Seminar(1 1/2 hrs.)

PERT Team- Pollution Emergency Response Team, Alberta Environmental Protection
(1 1/2 hrs.)

Depletion of the Ozone layer, greenhouse effect and acid rain all are issues dealt with in the new science programs. Karen will provide practical and current background and data on these issues. The PERT team will provide you with an overview of their important work as related to air quality in Alberta.and will be on site to demonstrate and explain their equipment and procedures. A visit to the air quality monitoring station in the adjacent Research Park is being planned. This workshop will provide solid background for the STS connections related to air quality issues.

Limit: 35 participants

Cooperative Learning in the 30-Level Science Classroom

Facilitators: Pat Adams and Don Johnson, Field Validation Teachers, Strathcona-Tweedsmuir School, Okotoks

Pat and Don have used cooperative learning techniques extensively in their classrooms in Science 10 and in the 20-Level sciences. They will guide you through an introduction to cooperative techniques they find effective. The workshop will provide and explore the specifics of implementing such techniques in the new 30-level courses. Of course you will "learn by doing"! If you have attended previous sessions and want a refresher with focus on the 30-levels you are welcome to come again.

Limit: 35 participants

Peer Evaluation: Optimizing Learning and Minimizing Teacher Stress

Facilitator: Susan Nesbitt, Teacher, McNally Composite High School

New Courses! Larger Classes! Decreased Preparation Time!

Do these statements sound familiar? In this exciting and practical workhsop, teachers will learn how to develop and use peer evaluation techniques to reduce their often overwhelming workloads, while increasing their students' communication, critical thinking and process skills. Unbelievable but true!

Limit: 35 participants

Tuesday PM Choices

Global Structure and Plate Tectonics
(Session run on Monday and repeated on Tuesday)

Facilitator: Dr. Alan Oldershaw, Geology Department, University of Calgary.

The history of the concept of plate tectonics is an excellent example of how earth scientists think and work and of how an hypothesis can be proposed, discarded, modified and then reinstated (but not necessarily by everyone). Partipants will examine the evolution of an idea, from continental drift through sea floor spreading, to the modern, unifying theory of plate motion and its consequences. Emphasis will be placed on the geological and geophysical methods used to determine the internal structure of the earth, the properties of lithospheric plates and the way in which they move. This session will be presented in a sequence of lectures and laboratory demonstrations. It will provide excellent background for the all day geological field trip on Wednesday, June 23.

Prerequisite: An open and critcial attitude.
Limit: 35 participants

Science 30 - Unit Practical Laboratory Examination
Facilitator: Dan Leskiw, Field Validation Teacher, Victoria Composite High

Come and sample unit laboratory skills examination for Science 30. Dan will lead teachers though the logistics of implementing such a summative skills assessment activity for a 30-level science course and facilitate the discussion and initial development of such examinations in all 30-level science courses, as required by participants.

Limit: 25 participants

*** The following two 1 1/2 hour workshops make up one 3 hour block-you sign up for both of them as a unit**

***Technology of Eye Surgery**
A Biology/Physics Bridge
Facilitator: Dr. Don Parker, Eye Surgeon, Calgary, AB

Dr. Parker will provide background on the modern technology and techniques associated with eye surgery, particularily cataract surgery. He will show film of various operations, lead discussion and answer questions.
(1 1/2 hrs)

***The Sports Medicine Connection**
Facilitator: Dr. Gordon Matheson, University of Calgary

Sports medicine is a high interest areas for students and provides a context for the integration of biological and physical science concepts. Dr. Matheson will provide information and examples in the sports medicine area which could be used effectively in the 30-level science courses.
(1 1/2 hrs.)

Unified Approach to Science 30
Teaching 30-Level Sciences to Locally Developed Themes
Facilitators: Rosa Andreiuk and Dawn Davidson
Field Validation Teachers, Central High School, Sedgewick

Rosa and Dawn have taught Science 10 and Science 20 to locally developed themes.and plan the same strategy for Science 30. They will use share their enthusiasm and experience in this workshop and facilitate a process which results in the development of a plan for teaching your particular 30-level course to locally developed themes.

Limit: 30 participants

The "Energeum" Trip
Facilitator: Andrea Main, Curator or the Energeum

The Energeum is an educational facility in Calgary which provides regular programming on the topic of energy as related to the elementary, junior high and senior high curriculum. Energy supply and demand and the relationship between energy consumption and the environment are dealt with in an thought provoking manner. A large, interactive computer board challenges students to apply the supply/demand concept to an imaginary planet while the "Oil Game" allows students to experience the effects of an embargo as they see how changes in supply and demand affect the selling price of oil. Andrea is tailoring a session to fit the needs of teachers implementing the new senior high science courses, with special focus on Science 30, Unit 4. Return transportation will be provided.

Limit: 35 participants

Determining Depth - Science 30 Guidelines
Facilitator: John Drader, Science 30 Examination Manager

Draft guidelines, in the form of sample questions which indicate depth of coverage in Science 30, have been developed by John and a committee of field validation teachers. These guidelines will be presented, discussed and modifications by the participants will be encouraged These guidelines, when completed, will provide a model of appropriate depth for item writers developing the Science 30 Diploma Examination. Come and have a voice in the coooperative process of determinating the appropriate level of questioning for this course. This dynamic development process requires your expertise.

Limit: 25 participants

Monday or Tuesday Evening Trip Option

Priddis Observatory Field Trip/Geological Background
Facilitator: Dr. David Fry-Department of Physics
Dr. Bill Wilson-Department of Physics

The Rothney Astrophysical Observatory (RAO) has a 16-inch and 60-inch telescope, used for optical and infrared work, mainly photometry and spectroscopy. The work in photometry includes measuring changes in brightness of binary star systems where one star periodically eclipses the other. The telescopes and the work done with them will be presented, along with basic astronomy, and some of the underlying physics of stars and electromagnetic radiation. Relevant topics include telescope mountings (the infrared telescope has an unconventional mounting), blackbody radiation and line spectra. If the weather permits, some smaller telescopes will be set up to allow viewing of some interesting object, though because it will be close to the summer slostice (shortest day), the sky will not be very dark. During the 45 minutes travelling from the U of C to the RAO, the local geology will be discussed. On the return journey, spectroscopy will be applied to street-lights.

Limit: 35 participants per session

BROADENED LEARNER EXPECTATIONS → ***BROADENED ASSESSMENT AND EVALUATION STRATEGIES***

STS Context / Skills

- **Thinking**
- **Communication – Oral/Written/AV**
- **Science Inquiry**
- **Technological Problem Solving**
- **Decision Making**
- **Cooperative/Independent Learning**
- **Self-Evaluation – "More student responsibility for learning"**

Unit Quizzes/Exams/Year-End Exam

- **STS Context Items**
- **STS Knowledge Items**
- **HMA Questions**

Skills Assessment/Evaluation

- **Performance Assessment**
- **Practical Test/Exams**

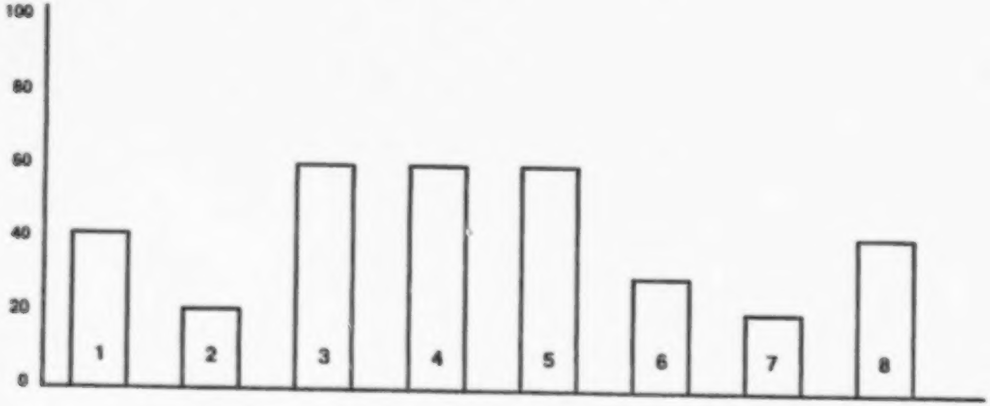
Research Projects

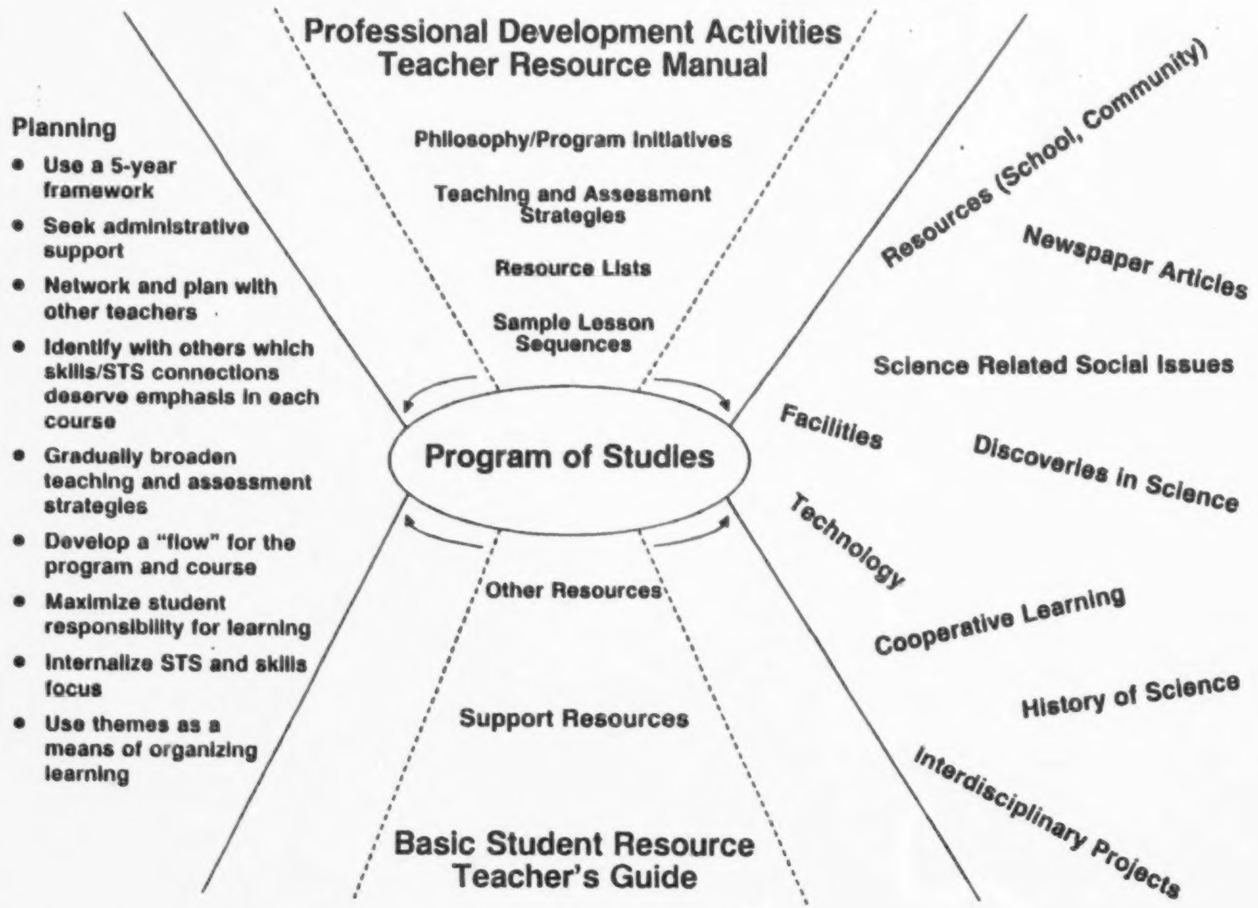
- **Written Assignments**
- **Presentations**
- **Debates/Role Play**

Cooperative Skills Assessment

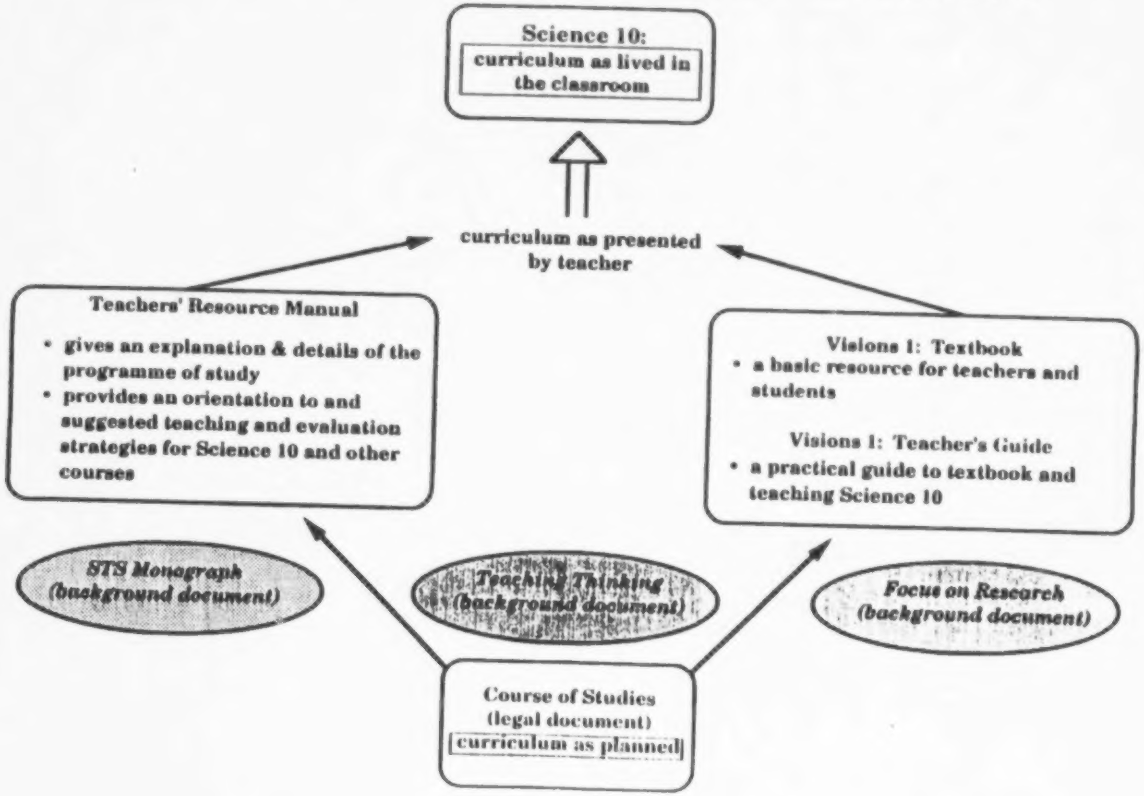
TEACHER AS FACILITATOR

1. Teaching for Thinking
2. Thematic Approach
3. STS Strategies
4. High Activity/Skills Focus
5. Focus on Research (library/community resources)
6. Technology and Media Integration
7. Cooperative Learning Strategies
8. Broaden Assessment and Evaluation Strategies




Professional Development Activities
Teacher Resource Manual
Philosophy/Program Initiatives
Teaching and Assessment Strategies
Resource Lists
Sample Lesson Sequences
Planning
• Use a 5-year framework
• Seek administrative support
• Network and plan with other teachers
• Identify with others which skills/STS connections deserve emphasis in each course
• Gradually broaden teaching and assessment strategies
• Develop a "flow" for the program and course
• Maximize student responsibility for learning
• Internalize STS and skills focus
• Use themes as a means of organizing learning
Program of Studies
Resources (School, Community)
Newspaper Articles
Science Related Social Issues
Facilities
Discoveries in Science
Technology
Cooperative Learning
History of Science
Interdisciplinary Projects
Other Resources
Support Resources
Basic Student Resource
Teacher's Guide

RELATIONSHIP OF CURRICULUM DOCUMENTS TO THE SCIENCE 10 COURSE


Science 10:
curriculum as lived in the classroom
curriculum as presented by teacher
Teachers' Resource Manual
• gives an explanation & details of the programme of study
• provides an orientation to and suggested teaching and evaluation strategies for Science 10 and other courses
Visions 1: Textbook
• a basic resource for teachers and students
Visions 1: Teacher's Guide
• a practical guide to textbook and teaching Science 10
STS Monograph (background document)
Teaching Thinking (background document)
Focus on Research (background document)
Course of Studies
(legal document)
curriculum as planned

Appendix G

Science 10
Course of Studies

Curriculum Standards Branch
Interim
May 31, 1994

Alberta
EDUCATION

SCIENCE

VISION STATEMENT: SENIOR HIGH SCIENCE PROGRAMS

The senior high science programs will help all students attain the scientific awareness needed to function as effective members of society. Students will be able to pursue further studies and careers in science, and come to a better understanding of themselves and the world around them. The same framework was used for the development of all the senior high science programs, including Science 10, Biology 20–30, Chemistry 20–30, Physics 20–30 and Science 20–30. The expected student knowledge, skills and attitudes are approached from a common philosophical position in each science course.

In the senior high science programs, students focus on learning the big interconnecting ideas and principles. These ideas, or major themes, originate from science knowledge that transcends and unifies the natural science disciplines. These themes include change, diversity, energy, equilibrium, matter and systems; the process by which scientific knowledge is developed, including the role of experimental evidence; and the connections among science, technology and society. In addition to forming a framework for the curriculum, these ideas provide continuity with the junior high program and build on students' previous learning.

The senior high science programs place an increased emphasis on developing methods of inquiry that characterize the study of science. For example, students will further their ability to ask questions, investigate and experiment; gather, analyze and assess scientific information; and test scientific principles and their applications. They will develop their problem-solving ability and use technology. By providing students with opportunities to develop and apply these skills, they will better understand the knowledge they have acquired.

Students will be expected to show an appreciation for the roles of science and technology in understanding nature. They will possess enthusiasm and positive attitudes toward science and maintain a lifelong interest in science.

The learning context is an integral part of the senior high science programs. It will foster the expected attitudes in students, further the development of students' skills and increase students' understanding of science knowledge, science process, and the connections among science, technology and society. The context for learning will be relevant so students will experience science as interesting and dynamic. Learning opportunities will be made meaningful by providing concrete experiences that students can relate to their world.

The senior high science programs place students at the centre. Students are active learners and will assume increased responsibility for their learning. They will appreciate the value of teamwork and make a positive contribution when working with others to solve problems and complete tasks.

SCIENCE 10

A. COURSE RATIONALE AND PHILOSOPHY

Science by its very nature is interesting, exciting and dynamic. Through the study of science, learners are given an opportunity to explore and understand the natural world and to become aware of the profound influence of science in their lives. Learning is facilitated by relating the study of science to what the learners already know, deem personally useful and consider relevant. Learning proceeds best when it originates from a base of concrete experiences presenting an authentic view of science. In Science 10, students learn science in relevant contexts and engage in meaningful activities. This facilitates the transfer of knowledge to new contexts. Students are encouraged to participate in lifelong learning about science and to appreciate it as an endeavour with practical impact on their own lives and on society as a whole.

Science is an experimental discipline requiring creativity and imagination. Methods of inquiry characterize its study. In Science 10, students further develop their ability to ask questions, investigate and experiment; to gather, analyze and assess scientific information; and to test scientific laws and principles and their applications. In the process, students exercise their creativity and develop their critical thinking skills. Through experimentation, problem-solving activities and independent study, students develop an understanding of the processes by which scientific knowledge evolves.

The Science 10 course places students at the centre. Students are active learners and will assume increased responsibility for their learning as they work through the course. A thorough study of science is required to give students an understanding that encourages them to make appropriate applications of scientific concepts to their daily lives and prepares them for future studies in science. Students are expected to participate actively in their own learning. An emphasis on the key concepts and principles of science provides students with a more unified view of the sciences and a greater awareness of the connections among them.

These science learnings will take varying amounts of time to acquire, depending on the individual learning styles and abilities of students. While the course is designed for approximately 125 hours, instructional time can be modified to meet the individual needs of students. Some students will require more than 125 hours, while others will require less.

GOALS

The major goals of the Science 10 course are:

- to develop in students an understanding of the interconnecting ideas and principles that transcend and unify the natural science disciplines
- to provide students with an enhanced understanding of the scientific world view, inquiry and enterprise

- to help students attain the level of scientific awareness essential for all citizens in a scientifically literate society
- to help students make informed decisions about further studies and careers in science
- to provide students with opportunities for acquiring knowledge, skills and attitudes that contribute to personal development.

Science 10 is an integrated academic course that helps students better understand and apply fundamental concepts and skills common to biology, chemistry, physics and the Earth sciences. Science 10 is a prerequisite for the 20-level science courses. The focus is on helping students understand the scientific principles behind the natural events they experience and the technology they use in their daily lives. The course encourages enthusiasm for the scientific enterprise and develops positive attitudes about science as an interesting human activity with personal meaning. It develops in students the knowledge, skills and attitudes to help them become capable of, and committed to, setting goals, making informed choices and acting in ways that will improve their own lives and life in their communities.

B. GENERAL LEARNER EXPECTATIONS

The general learner expectations outline the many facets of scientific awareness and serve as the foundation for the specific learner expectations covered in section C. The general learner expectations are developed in two categories: *program* expectations and *course* expectations.

PROGRAM GENERAL LEARNER EXPECTATIONS

Science 10 serves as the prerequisite for Biology 20–30, Chemistry 20–30, Physics 20–30 and Science 20–30. The *program* general learner expectations listed here apply to Science 10 in combination with each of the other four programs.

The *program* general learner expectations are broad statements of science attitudes, knowledge, skills and science, technology and society (STS) connections that students are expected to achieve in all of the senior high school science programs. These *program* general learner expectations are further refined through the *course* general learner expectations and then developed in specific detail through the study of individual units in Science 10 and each of the sciences at the 20 and 30 level. All expectations follow a progression from Science 10 through to each of the 30-level sciences, and though listed separately, are meant to be developed in conjunction with one another, within a context.

ATTITUDES

Students will be encouraged to develop:

- enthusiasm for, and a continuing interest in, science
- affective attributes of scientists at work; such as, respect for evidence, tolerance of uncertainty, intellectual honesty, creativity, perseverance, cooperation, curiosity and a desire to understand
- positive attitudes toward scientific skills involving mathematics, problem-solving and process skills
- open-mindedness and respect for the points of view of others
- sensitivity to the living and nonliving environment
- appreciation of the roles of science and technology in our understanding of the natural world.

KNOWLEDGE

Science Themes

Students will be expected to demonstrate an understanding of themes that transcend the discipline boundaries, and show the unity among the natural sciences, including:

- Change: how all natural entities are modified over time, how the direction of change might be predicted and, in some instances, how change can be controlled
- Diversity: the array of living and nonliving forms of matter and the procedures used to understand, classify and distinguish those forms on the basis of recurring patterns
- Energy: the capacity for doing work that drives much of what takes place in the Universe through its variety of interconvertible forms
- Equilibrium: the state in which opposing forces or processes balance in a static or dynamic way
- Matter: the constituent parts, and the variety of states of the material in the physical world

- Systems: the interrelated groups of things or events that can be defined by their boundaries and, in some instances, by their inputs and outputs.

SKILLS

Students will be expected to develop an ability to use thinking processes associated with the practice of science for understanding and exploring natural phenomena, problem solving and decision making. Students will also be expected to use teamwork, respect the points of view of others, make reasonable compromises, contribute ideas and effort, and lead when appropriate to achieve the best results. These processes involve many skills that are to be developed within the context of the program content.

The skills framework presented here assumes that thinking processes often begin with an unresolved problem or issue, or an unanswered question. The problem, issue or question is usually defined and hypotheses formulated before information gathering can begin. At certain points in the process, the information needs to be organized and analyzed. Additional ideas may be generated—for example, by prediction or inference—and these new ideas, when incorporated into previous learning, can create a new knowledge structure. Eventually, an outcome, such as a solution, an answer or a decision is reached. Finally, criteria are established to judge ideas and information in order to assess both the problem-solving process and its outcomes.

The following skills are not intended to be developed sequentially or separately. Effective thinking appears to be nonlinear and recursive. Students should be able to access skills and strategies flexibly; select and use a skill, process or technology that is appropriate to the task; and monitor, modify or replace it with a more effective strategy.

- Initiating and Planning
  - identify and clearly state the problem or issue to be investigated
  - differentiate between relevant and irrelevant data or information
  - assemble and record background information
  - identify all variables and controls
  - identify materials and apparatus required
  - formulate questions, hypotheses and/or predictions to guide research
  - design and/or describe a plan for research, or to solve a problem
  - prepare required observation charts or diagrams, and carry out preliminary calculations

- Collecting and Recording
  - carry out the procedure and modify, if necessary
  - organize and correctly use apparatus and materials to collect reliable data
  - observe, gather and record data or information accurately according to safety regulations; e.g., Workplace Hazardous Materials Information System (WHMIS), and environmental considerations

- Organizing and Communicating
  - organize and present data (themes, groups, tables, graphs, flow charts and Venn diagrams) in a concise and effective form
  - communicate data more effectively, using mathematical and statistical calculations, where necessary
  - express measured and calculated quantities to the appropriate number of significant digits, using SI notation for all quantities
  - communicate findings of investigations in a clearly written report

- Analyzing
  - analyze data or information for trends, patterns, relationships, reliability and accuracy
  - identify and discuss sources of error and their affect on results
  - identify assumptions, attributes, biases, claims or reasons
  - identify main ideas

- Connecting, Synthesizing and Integrating
  - predict from data or information, and determine whether or not these data verify or falsify the hypothesis and/or prediction
  - formulate further testable hypotheses supported by the knowledge and understanding generated
  - identify further problems or issues to be investigated
  - identify alternative courses of action, experimental designs, and solutions to problems for consideration
  - propose and explain interpretations or conclusions
  - develop theoretical explanations
  - relate the data or information to laws, principles, models or theories identified in background information
  - propose solutions to a problem being investigated
  - summarize and communicate findings
  - decide on a course of action

- Evaluating the Process or Outcomes
  - establish criteria to judge data or information
  - consider consequences and biases, assumptions and perspectives
  - identify limitations of the data or information, and interpretations or conclusions, as a result of the experimental/research/project/design process or method used
  - evaluate and suggest alternatives and consider improvements to the experimental technique and design, the decision-making or the problem-solving process
  - evaluate and assess ideas, information and alternatives

CONNECTIONS AMONG SCIENCE, TECHNOLOGY AND SOCIETY

Science, Technology and Society (STS)

Students will be expected to demonstrate an understanding of the processes by which scientific knowledge is developed, and of the interrelationships among science, technology and society, including:

- the central role of evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted

- the inability of science to provide complete answers to all questions

- the functioning of products or processes based on scientific principles

- the ways in which science advances technology and technology advances science

- the use of technology to solve practical problems

- the limitations of scientific knowledge and technology

- the influence of the needs, interests and financial support of society on scientific and technological research

- the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations.

FURTHER READING

For a more detailed discussion on how to integrate thinking and research skills into the science classroom, refer to the Alberta Education publications: *Teaching Thinking: Enhancing Learning*, 1990 and *Focus on Research: A Guide to Developing Students' Research Skills*, 1990.

For further reading on integrating science, technology and society into the classroom, refer to the Alberta Education publication: *STS Science Education: Unifying the Goals of Science Education*, 1990.

COURSE GENERAL LEARNER EXPECTATIONS

The *course* general learner expectations are specific to Science 10 and provide a bridge between the *program* general learner expectations and the specific learner expectations for each unit of study.

The attitudes expectations refer to those predispositions that are to be fostered in students. These expectations encompass attitudes toward science, the role of science and technology, and the contributions of science and technology toward society. The knowledge expectations are the major science concepts in the course. The skills expectations refer to the thinking processes and abilities associated with the practice of science, including understanding and exploring natural phenomena, and problem solving. The connections among science, technology and society expectations focus on the processes by which scientific knowledge is developed and on the interrelationships among science, technology and society.

The last *course* expectation links together the study of science, careers, everyday life and subsequent studies.

Although itemized separately, the attitudes, knowledge, skills and STS connections are meant to be developed together within one or more of the contexts listed.

Attitudes

Students will be encouraged to:

- appreciate the role of empirical evidence and models in science, and accept the uncertainty in explanations and interpretations of observed phenomena
- value the curiosity, openness to new ideas, creativity, perseverance and cooperative hard work required of scientists, and strive to develop these same personal characteristics
- appreciate the role of science and technology in advancing our understanding of the natural world, be open-minded and respectful of other points of view when evaluating scientific information and its applications, and appreciate that the application of science and technology by humankind can have both beneficial and harmful effects and can cause ethical dilemmas
- show a continuing interest in science, appreciate the need for computational competence, problem-solving and process skills when doing science, and value accuracy and honesty when communicating the results of problems and investigations
- appreciate the contributions of the various science disciplines and mathematics to our understanding of the natural world, and appreciate the multidimensional nature of issues arising from the interrelationships among science, technology and society.

Students should be able to:

Knowledge

- describe how energy and matter are transferred in all physical and biochemical changes; and identify energy transfers in the hydrologic cycle, photosynthesis and cellular respiration, the combustion of fuels, and energy conversion devices
- explain that energy and matter exist in many forms and are transferred, moved and conserved in and among physical, chemical and biological systems
- apply the law of energy conservation to energy transfer, calculating efficiency; and identify ways of conserving energy
- use the relationships among force, distance, work, energy and time to describe how energy is measured; and compare the functioning of common energy conversion devices
- apply the principle of conservation of matter to calculations and investigations into chemical changes that produce substances useful to society and/or may have unpredictable effects on the environment

- describe atoms, ions and molecules; and investigate the chemical and physical properties of common elements and compounds; and apply the classification system to identify elements, ionic and molecular compounds, and common household substances

Skills

- perform investigations, tasks and procedures, designed by others, that have a few, simple variables, yield direct evidence, and require empirically-based explanations

- collect, verify and organize data into tables, graphs and diagrams designed by others, and put into written form; and describe findings or relationships, using scientific vocabulary, notation and concepts

- plot data that yield straight-line graphs; and use appropriate SI notation, fundamental and derived units and formulas; and determine slopes of, and areas under, straight-line graphs

- use mathematical language of ratio and proportion, and simple equations, to solve numerical problems; and use chemical equations and nomenclature to communicate scientific ideas, relationships and concepts

Connections Among Science, Technology and Society

- list for a given instance, appropriate and relevant examples that relate direct scientific evidence to a theory; and describe the limitations of science and technology in answering all questions and solving all problems

- list for a given instance, appropriate and relevant examples of technological solutions to practical problems; and describe the functioning of technologies, using scientific principles; and relate the ways in which science and technology advance one another

- identify for a given instance, appropriate and relevant examples that show how science and technology are influenced and supported by society; and describe the responsibility of society through science and technology to protect the environment and use natural resources wisely

- identify subject-related careers and apply the skills and knowledge acquired in Science 10 to everyday life and to related and new concepts in subsequent studies of science.

C. SPECIFIC LEARNER EXPECTATIONS

LEARNING CYCLE

The specific learner expectations consist of the knowledge, skills and attitudes that are to be addressed in Science 10. The use of the learning cycle allows students to progress from:

- an introduction framing the lesson in an STS connection relevant to the lives of the learners, and makes connections between past and present learning experiences, as well as anticipates activities to focus students' thinking on the learning outcomes of the activity, to
- the experiential exploration of new content that provides students with a common base of experiences within which they identify and develop key concepts, processes and skills, through
- a hypothesis-building phase where concepts are developed to describe a particular aspect of their experiential exploration, and opportunities are provided to communicate their conceptual understanding, or demonstrate their skills or behaviours, to
- an elaboration phase that extends understanding of key concepts and allows further opportunities to practise desired skills and problem-solving strategies, to
- an application phase where the hypotheses, vocabulary and patterns previously developed are applied to new situations and related to key concepts and principles of science, to
- a final evaluation of the significance of the new learning in an STS context to assess their understanding and abilities, and provide opportunities for teachers to evaluate student progress toward achieving the curriculum standards.

In science, students examine phenomena in a variety of topics to show the relationships among the sciences. Wherever possible, examples should be framed in the context of the learners' own experiences to enable them to make the connections between scientific knowledge and the society around them, the technology that societies have developed, and the nature of science itself.

COURSE OVERVIEW

The Science 10 course emphasizes four of the key concepts of science: *change, energy, matter* and systems. The concepts of *diversity* and *equilibrium* are included as well but receive less emphasis. These themes provide a means of showing the connections among the scientific disciplines, and provide a framework for teachers to show students how individual sections of the course relate to the big ideas of science.

In addition to developing a solid understanding of the fundamental science concepts and principles, Science 10 has the goal of educating students about the nature of science and technology, and the interaction between science and technology. Students must be aware of the tremendous impact of science and associated technology on society, but at the same time they must be aware of the roles and limitations of the sciences and technology in problem solving in a societal context.

The major concepts allow connections to be drawn among the four units of the course.

Science 10 consists of four units of study:

Unit 1:	Energy from the Sun
Unit 2:	Energy and Matter in Living Systems
Unit 3:	Energy and Matter in Chemical Change
Unit 4:	Change and Energy.

Unit 1 focuses on the role of radiant energy from the Sun in sustaining life and driving weather *systems* on Earth. In Unit 2, the processes by which *energy* and *matter* are exchanged between living *systems* and their environment are studied, and change is illustrated by the growth of living organisms. Unit 3 investigates the *changes* in *energy* and *matter* that occur during chemical reactions. Unit 4 examines different forms of *energy* and the principles that govern *energy* transformations.

UNIT 1
ENERGY FROM THE SUN

OVERVIEW

Science Themes: *Energy*, *Matter* and *Systems*

In Unit 1, students investigate how radiant *energy* from the Sun sustains life and drives weather *systems* on Earth. The properties of water are studied and compared with the properties of other forms of *matter*. Students investigate the role of water in moderating the *changes* in the Sun's *energy* as it moves through the biosphere.

This unit builds on Science 8, Unit 5: Growing Plants; and Science 9, Unit 3: Heat Energy: Transfer and Conservation, and provides students with a foundation for the study of *ecosystems* and alternative *energy* sources in the 20- and 30-level science courses.

The three major concepts developed in this unit are:

- *energy* from the Sun sustains life on Earth
- the properties of water, relative to other forms of *matter*, profoundly influence the nature of life on Earth
- *energy* from the Sun determines climate and drives weather *systems*.

In this unit, *students will develop* an ability to use the skills and thinking processes associated with the practice of science, emphasizing:

- collecting and recording
- organizing and communicating
- analyzing data from investigations of the Sun's *energy* and the properties of water.

The STS connections in this unit illustrate:

- the functioning of products or processes based on scientific principles
- the use of technology to solve practical problems
- the limitations of scientific knowledge and technology.

ATTITUDES

Students will be encouraged to:

- develop a questioning attitude concerning natural phenomena
- appreciate the importance of solar *energy* in sustaining life and driving weather *systems* on Earth
- appreciate the importance of water in determining the nature of life on Earth
- recognize that scientific knowledge of meteorological phenomena is cumulative and subject to *change*
- recognize the limits of current scientific theories in predicting natural phenomena, such as weather.

MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:

1. *Energy* from the Sun sustains life on Earth.	• energy from the Sun sustains life on Earth, by extending from Science 8, Unit 5, the life processes of plants, and by:
	  • defining photosynthesis as the process by which green plants (producers) put together carbon dioxide and water to store energy and form carbohydrates and oxygen
	  • defining aerobic respiration as the process by which organisms (consumers) release energy by reacting on carbohydrates and oxygen to form carbon dioxide and water
	  • describing how photosynthesis and aerobic respiration are the reverse of each other
	  • indicating that all life on Earth exists in the biosphere, a relatively thin spherical shell having an approximate thickness of 15 kilometres
	  • indicating that the biosphere exists within the three major spherical layers of Earth—the atmosphere, the hydrosphere and the lithosphere
	  • explaining how energy flow through the biosphere is facilitated by different types of organisms; i.e., producers, consumers and decomposers
	  • defining open, closed and isolated systems; i.e.,
	    – open system: exchanges both energy and matter with its surroundings
	    – closed system: exchanges energy but not matter with its surroundings
	    – isolated system: does not exchange matter or energy with its surroundings.

SKILLS

Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:

- performing an experiment to demonstrate the role of light energy in the production of carbohydrates and oxygen by green plants
- identifying the manipulated, responding and controlled variables (variables held constant) in an experimental investigation of photosynthesis
- distinguishing between a controlled variable and a control experiment (an experiment carried out under the same conditions as another experiment except for one factor)
- designing a closed system to illustrate the dynamic balance between photosynthesis and respiration
- tracing the flow of energy through the biosphere, interrelating autotrophic and heterotrophic matter needs by comparing representative producers and consumers.

STS CONNECTIONS

Students should be able to demonstrate the interrelationships among science, technology and society, by:

- understanding that energy from the Sun sustains life in the biosphere through the processes of photosynthesis and respiration, within the context of:
  - tracing the energy contained in a typical student lunch to its source in the Sun, using the laws of thermodynamics

    OR
  - describing the ability and responsibility of society, through science and technology, to protect the environment and use natural resources judiciously to ensure quality of life for future generations; e.g., global deforestation

    OR
  - investigating the ways in which technology advances science; e.g., attempts to establish artificial ecosystems in a large closed system, such as Biosphere II

    OR
  - any other relevant context.

MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
2. The properties of water, relative to other forms of *matter*, profoundly influence the nature of life on Earth.	• the properties of water, including surface tension, melting point, boiling point, specific heat capacity, heat of fusion, heat of vaporization, expansion on freezing, and maximum density at 4°C, profoundly influence the nature of life on Earth, by: • extending from Science 9, Unit 3, that heat is a form of energy and may be quantified using $Q = mc\Delta T$ • calculating the thermal energy involved when a measured mass of water undergoes a measured temperature change • calculating the thermal energy involved when a measured mass of water undergoes a phase change • relating the hydrologic cycle to solar energy • relating the properties of water to the maintenance of constant body temperature • indicating why ice forms on the surface of water, and relating this to the winter survival of aquatic organisms • describing how the properties of water are due to the polar nature of the water molecule • explaining the effect of thermal energy on matter, using the kinetic molecular theory as a simple mechanical model • describing temperature changes in terms of changes in the kinetic energy of the molecules of a substance • describing phase changes in terms of the kinetic molecular theory.

SKILLS

Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:

- observing and recording some of the physical properties of water
- collecting and graphing data showing the effect of heat on the temperature of water
- performing an experiment to determine the heat of fusion of ice
- calculating any variable in the equation, $Q = mc\Delta T$, given the other three variables
- graphing and analyzing data showing how the density of water varies with temperature
- designing an experiment to investigate the change in volume of water upon freezing.

STS CONNECTIONS

Students should be able to demonstrate the interrelationships among science, technology and society, by:

- understanding that the properties of water, including surface tension, melting point, boiling point, specific heat capacity, heat of fusion, heat of vaporization, expansion on freezing, and maximum density at 4°C, profoundly influence the nature of life on Earth, including the maintenance of constant body temperature, the winter survival of aquatic organisms; and the operation of the hydrologic cycle, within the context of:
  - explaining the scientific principles involved in the technologies that use water to maintain a uniform temperature in buildings

    OR

  - describing the use of technology to solve practical problems; e.g., construction methods that account for the expansion of water upon freezing; and technologies that use solar energy to desalinate water

    OR

  - any other relevant context.

MAJOR CONCEPT	KNOWLEDGE
	Students should be able to demonstrate an understanding that:
3. *Energy* from the Sun determines climate and drives weather *systems*.	• energy from the Sun determines climate and drives weather systems, by: • explaining the principal factors that determine climate; i.e., large bodies of water, ocean currents, latitude, surface characteristics • explaining the significance of the differential solar heating of equatorial and polar regions in the transfer of thermal energy • explaining weather changes in terms of pressure systems, cold and warm fronts, and the Coriolis effect • explaining a local weather phenomenon; e.g., chinooks, thunderstorms, hailstorms or tornadoes.

SKILLS	STS CONNECTIONS
Students should be able to demonstrate the skills and thinking processes associated with the practice of science, by:	*Students should be able to demonstrate the interrelationships among science, technology and society, by:* • understanding that weather systems, such as chinooks, thunderstorms, hailstorms and tornadoes, are driven by energy from the Sun through the mechanisms of vertical air currents, pressure systems, cold and warm fronts and the Coriolis effect, and that climate is strongly effected by large bodies of water, ocean currents and latitude, within the context of:
• comparing mean monthly temperature data for cities of similar latitude and accounting for any differences • constructing and interpreting climate graphs • designing an experiment to investigate the heating effect of solar energy • performing an experiment to investigate the heat changes involved in the compression and expansion of air • communicating meteorological data in SI units; e.g., temperature, wind velocity, atmospheric pressure, precipitation • interpreting weather maps of local weather • comparing weather forecasts to observed weather.	• describing the use of technology to solve practical problems; e.g., the operation of weather satellites in monitoring weather systems OR • describing the limitations of scientific knowledge and technology; e.g., how more accurate weather predictions could benefit millions of people globally OR • describing the technology used to monitor levels of atmospheric gases OR • describing the central role of experimental evidence in the accumulation of knowledge, and the way in which proposed theories may be supported, modified or refuted; e.g., using a greenhouse as a model of Earth's atmosphere OR • any other relevant context.

Appendix H

SCIENCE 10 INSERVICE

EVALUATION AND ASSESSMENT

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EVALUATION =

QUANTITATIVE DESCRIPTIONS (measurement)

and/or

QUALITATIVE DESCRIPTIONS (nonmeasurement)

plus

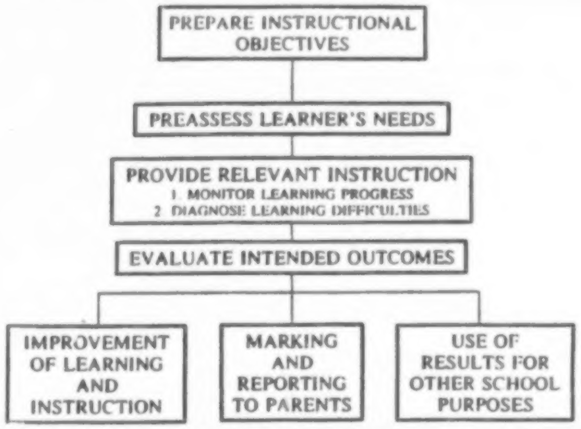
VALUE JUDGMENTS

PURPOSE OF EVALUATION

1. CLARIFY LEARNING OUTCOMES
2. PROVIDE SHORT-TERM GOALS
3. PROVIDE FEEDBACK ABOUT LEARNING
4. PROVIDE FEEDBACK ABOUT DIFFICULTIES
5. JUDGE INSTRUCTIONAL OBJECTIVES
6. JUDGE EFFECTIVENESS OF INSTRUCTION

AND

7. ASSIGN MARKS



PREPARE INSTRUCTIONAL OBJECTIVES

PREASSESS LEARNER'S NEEDS

PROVIDE RELEVANT INSTRUCTION
1. MONITOR LEARNING PROGRESS
2. DIAGNOSE LEARNING DIFFICULTIES

EVALUATE INTENDED OUTCOMES

IMPROVEMENT OF LEARNING AND INSTRUCTION

MARKING AND REPORTING TO PARENTS

USE OF RESULTS FOR OTHER SCHOOL PURPOSES

CLASSROOM EVALUATION PROCEDURES

FORMATIVE	DETERMINE LEARNING PROGRESS, PROVIDE FEEDBACK FOR REINFORCEMENT OF LEARNING AND CORRECT LEARNING ERRORS	TEACHER-MADE MASTERY MASTERY TESTS; CUSTOM-MADE TEST FROM PUB TESTS FROM PUBLISHERS, OBSERVATIONAL TECHNIQUES
DIAGNOSTIC	DETERMINE CAUSES (intellectual, physical, emotional, environmental) OF PERSISTENT LEARNING DIFFICULTIES	PUBLISHED DIAGNOSTIC TESTS; TEACHER-MADE DIAGNOSTIC TESTS, OBSERVATIONAL TECHNIQUES
SUMMATIVE	DETERMINE END-OF-COURSE ACHIEVEMENT FOR ASSIGNING GRADES OR CERTIFYING MASTERY OF OBJECTIVES	TEACHER-MADE SURVEY TESTS; PERFORMANCE RATING SCALES, PRODUCT SCALES

ASSESSMENT QUESTIONS

WHAT IS THE PURPOSE OF ASSESSMENT?

WHAT KIND OF ASSESSMENT IN SCIENCE?

WHAT DO WE WANT TO ASSESS?

WHAT KIND OF ACTIVITY SHOULD WE SEE?

STUDENT PRODUCTS

SCIENCE PRODUCTS

WHAT ARE STUDENT PRODUCTS?

WHY STUDENT PRODUCTS?

ADVANTAGES OF STUDENT PRODUCTS

ASSESSMENT METHODS

STUDENT PORTFOLIOS

SCIENCE PORTFOLIOS

WHAT IS IN A PORTFOLIO?

ADVANTAGES OF PORTFOLIOS

STUDENT ATTITUDES

ASSESSMENT OF PORTFOLIOS

INVESTIGATIONS IN SCIENCE

COMBINING INSTRUCTION WITH ASSESSMENT

INTEGRATED CURRICULUM

COMBINING SEVERAL MODES OF ASSESSMENT

SCIENCE INQUIRY REVIEWS

PERFORMANCE ASSESSMENT

STUDENTS DOING SCIENCE

FORMS OF ASSESSMENT

ADVANTAGES OF PERFORMANCE ASSESSMENT

SCIENCE ASSESSMENT ALTERNATIVES

VISION FOR SCIENCE EDUCATION

ASSESSMENT IN CLASSROOMS

NEW ASSESSMENT TECHNIQUES

AUTHENTIC ASSESSMENT

AUGUST PREVIEW

CHOICE AND SUPPLY TYPE ITEM WORKSHOP

ITEM DEVELOPMENT FOR NEW CURRICULUM

ASSESSMENT STRATEGIES FOR SCIENCE INQUIRY

ASSESSMENT BANK NETWORK

A MODEL
FOR THE
ASSESSMENT AND EVALUATION
OF
SCIENTIFIC PROBLEM-SOLVING SKILLS

STUDENT EVALUATION BRANCH

DRAFT, June 8, 1992

Large Scale Assessment of the Problem-Solving Skills* in Science

Rationale

Teachers diagnose and assess student growth on a regular basis as part of their teaching duties. For students to learn what is meant by the nature and the processes of science, it is essential that they spend much of their time doing science activities. This requires a model for teachers to use in developing a methodology for assessing and diagnosing students' achievements in problem-solving and science process skills. This presentation will discuss Alberta Education's initiative in developing such a model.

Alberta Education has responsibility for assisting in the establishment of educational standards at provincial and local levels. These educational standards encompass curriculum standards (what students need to know, with learning sequenced into levels of complexity), assessment standards (the criteria used to decide what level a student has attained), and achievement standards (how many Alberta students are expected to reach a particular curriculum level, at a specific age or year in school). At the grade twelve level the Student Evaluation Branch has developed diploma examinations, that are based on the provincial Program of Studies. A student's final mark for courses in which there are provincial diploma examinations consists of an equal weighting of the school-awarded mark and the diploma-examination mark.

To assist teachers in the establishment of valid and reliable evaluation practices that are consistent with the philosophy of science courses, Student Evaluation has undertaken to develop a model for the evaluation of the practical components of problem solving in science courses. The model is intended to accomplish two goals:

1. to provide a means for raising attainment of problem-solving skills through the use of a model that clarifies the learning outcomes; and
2. to provide a consistent model for assessment that can be used in the classroom as well as for assessment on a provincial basis.

Once the model is validated, teachers may be required to use it as the basis for providing Alberta Education with a mark that reflects a student's achievement on the practical component of a science diploma course. A student's final grade for a science diploma course would then be made up using 20% from the practical-component mark, 40% from the school-awarded mark and 40% from the diploma-examination mark.

Nature of Science and Student Development

The assessment and evaluation model is constructed on the premise that elementary science students are capable of inductive reasoning; that is, they can form generalizations from patterns in data that are derived from specific observations of natural phenomena. These generalizations may suggest simple predictions that can lead to testing procedures; which if carried out, can promote a rudimentary understanding of the nature of evidence.

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*The use of processes and their component skills to obtain a solution in a specific context.

Students who have experienced growth in problem-solving skills should recognize patterns in scientific data. Recognizable patterns should suggest causal questions. Tentative answers to these questions can then be developed in the form of hypotheses. The formation of hypotheses draws on previous experience with analogous situations, as well as creative imagination. This hypothetico-deductive reasoning process generates the need for further testing (experimentation). The process of testing will encourage the development of an understanding of the nature of *verification* versus *falsification*.

Mature students will appreciate that a concept or hypothesis is never examined in isolation. An explanation is always tested in the context of a network of concepts and methodological presuppositons. These large frameworks or paradigms are slow to change because they are the products of particular historical communities. The acceptance of a paradigm includes a lot of vested interest.

Mature students will demonstrate ability to evaluate scientific theories. They will recognize that agreement with data as well as predictive success constitute impressive support for a theory. A theory should also be consistent with other accepted theories, that is, demonstrate coherence. A theory is of value if it brings together previously separated domains. A theory is also of value if it generates new hypotheses, thereby encouraging further research by the scientific community.

The Assessment Model

The model for assessing problem-solving activities in science, such as laboratory investigations, library research projects, field surveys, interviews, etc., has three sections to be validated by teachers:

1. a set of criterion-referenced statements within a problem-solving framework arranged to communicate four or five levels of achievement;
2. a student profile sheet to be used by the teacher to record student achievement based on the model; and
3. a class profile sheet for teachers to record an overall assessment of each student in terms of a mark to be assigned for the practical component of the course.

The model focuses on a criterion-referenced description of the problem-solving skills found in science courses. The criteria take into account growth in cognitive and psychomotor skills as students progress to the level of skill development demanded by senior high school science courses. The problem-solving framework consists of six major components for which essential criteria have been identified. They are as follows:

A. Initiating and Planning
B. Collecting and Recording
C. Organizing and Communicating
D. Analyzing
E. Connecting, Synthesizing and Integrating
F. Evaluating the Process or Outcomes

The criteria have been organized to demonstrate four or five levels of competence in the development of each of the six components. The levels indicated in this model are to be validated by classroom teachers who will indicate the acceptable standard for student achievement in problem-solving skills in elementary, upper elementary, junior high and senior high school classrooms. A student will be required to demonstrate achievement at a particular level in a particular component several times before being assigned that level of achievement. Although a student may be able to demonstrate achievement at various levels throughout this model, a specific overall level of achievement should not be assigned until the student is given the opportunity to repeatedly demonstrate achievement on all components at the level being assigned.

Upon validation, it is anticipated that the provincial achievement standards will require the majority of students at the modal age/grade to be able to demonstrate achievement at the corresponding level. By knowing the criteria to be used in assessing students with respect to problem-solving skills, and how the criteria at a given level fit into the overall development of these skills, teachers will be able to use many different activities that will allow for individual student needs and satisfy the specific learner expectations of a given course.

Follow-up Activities

Subsequent to validating the assessment model as a means for representing the general problem-solving skills involved in all science courses, a document should be developed that outlines specific skills or techniques that are deemed to be essential for a given course. For example, a chemistry course may require student proficiency in titration; a biology course may require the use of a microscope; and junior high students may need to demonstrate proficiency in the use of a balance and a Bunsen burner or hot plate. These 'special' practical skill requirements will need to be formalized for each course to ensure a common understanding of the overall performance required by a student to achieve a passing grade in the course.

It should also be noted that this model was developed initially to focus on problem-solving skills as used in the context of a laboratory. Therefore, additional criterion-referenced descriptions for broader assessment strategies may be required.

A FRAMEWORK FOR SCIENTIFIC PROBLEM-SOLVING SKILLS

A.	Initiating and Planning	• identify and clearly state the problem or issue to be investigated • differentiate between relevant and irrelevant data or information • assemble and record background information • identify all variables and controls • identify materials and apparatus required • formulate questions, hypotheses and/or predictions to guide research • design and/or describe a plan for research or to solve the problem • prepare required observation charts or diagrams
B.	Collecting and Recording	• carry out and modify the procedure if necessary • organize and correctly use apparatus and materials to collect reliable experimental data • accurately observe, gather and record information or data according to safety regulations (e.g., WHMIS) and environmental considerations
C.	Organizing and Communicating	• organize and present data in a concise and effective form (themes, groups, tables, graphs, flow charts and Venn diagrams) • communicate data more effectively, using mathematical and statistical calculations where necessary • express measured and calculated quantities to the appropriate number of significant digits and use appropriate SI units for all quantities

D. Analyzing	• analyze data and information for trends, patterns, relationships, reliability and accuracy • identify and discuss sources of error and their effect on results • identify assumptions, attributes, bias, claims or reasons • identify main ideas
E. Connecting, Synthesizing and Integrating	• predict from data or information • formulate further testable hypotheses supported by the knowledge and understanding generated • identify alternatives for consideration • propose and explain interpretations or conclusions • develop theoretical explanations • relate the data to laws, principles, models or theories identified in background information • answer the problem investigated • summarize and communicate finding • decide on a course of action
F. Evaluating the Process or Outcomes	• establish criteria to judge data or information • consider consequences and perspectives • identify limitation of the data, and information, interpretations or conclusions as a result of the experimental/research/project/design, processes or methods used • suggest alternatives and consider improvements to experimental technique and design • evaluate and assess ideas, information and alternatives

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS
A. INITIATING AND PLANNING

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
• Proposes a simple problem statement when initiated to do so	• Proposes a simple problem statement	• Proposes a problem to be investigated	• Clearly states the purposes and problem to be investigated
• Background information must be supplied	• Background information is supplied from teacher or student's own experience	• Background supplied by teacher, reference material or student's own experience	• Prepares the necessary background information from references, research, discussion and/or past experience
• Identifies those things that change and those that stay the same	• Identifies variables and controls	• Identifies controls, manipulated variables and responding variables	• Identifies the controls and variables
• Guesses about the outcomes	• Makes 'educated' guesses	• Makes a prediction and/or suggests a simple hypothesis	• Forms an appropriate hypothesis and prediction • Designs an investigation
• Identifies simple materials and equipment to be used	• Identifies materials and equipment to be used • Is able to assemble simple apparatus	• Identifies the materials and equipment to be used • Assembles simple apparatus	• Identifies and names the materials and equipment to be used • Assembles and designs or modifies simple apparatus
• Follows directions as provided	• Follows directions as provided • Is able to write simple procedural statements	• Develops and organizes a simple written procedure	• Designs and writes descriptions of procedures that are clear and detailed
	• Prepares observation charts, tables and diagrams as directed by teacher	• Prepares observation charts, tables, diagrams, graphs • Performs calculations as outlined by teacher	• Prepares observation charts, diagrams and graphs • Performs necessary calculations

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS
B. COLLECTING AND RECORDING

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
• Follows a simple procedure	• Follows a simple procedure	• Follows a given procedure and is able to suggest modifications when asked to do so	• Follows a given procedure and modifies the procedure when necessary
• Correctly uses apparatus and materials as directed by teacher	• Correctly uses apparatus and materials with little teacher assistance	• Correctly uses apparatus and materials with infrequent modification	• Consistently uses standard apparatus and materials correctly
• Collects data using concrete, tangible objects	• Collects tangible objects • Carries out simple measurements	• Accurately collects data	• Accurately collects relevant data
• Records data in sentence form or in simple charts that have been constructed	• Records data in numerical and non-numerical form • Is able to use and construct simple charts	• Record relevant data including the correct units with respect to measured data	• Records relevant data using the appropriate units
• Is aware of safety and environmental concerns • Follows stated safety procedures	• Is aware of safety and environmental concerns • Follows stated safety procedures	• Shows appropriate safety and environmental concerns in the use, care and maintenance of materials and apparatus	• Demonstrates appropriate standards of safety
		• Is able to locate appropriate safety regulations • Actively participates in teacher-directed discussion of safety and environmental issues	• Is able to suggest modifications to procedures to minimize environmental damage

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS
C. ORGANIZING AND COMMUNICATING

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
• Organizes data in sets of concrete objects	• Organizes data in sets of objects	• Organizes data in the form of sets, themes and/or tables	• Organizes data accurately
	• Provides a basis for the organization of data sets • Constructs simple graphs to represent the data	• Provides a basis for and suggests alternatives for the organization of data • Is able to construct graphs and/or tables to represent the data	• Is able to represent data using appropriate graphs and tables
	• Performs basic mathematical calculations	• Performs basic mathematical calculations	• Performs relevant and required mathematical calculations
	• Identifies, with teacher assistance, errors and inaccuracies	• Identifies errors and discrepancies in data • Takes part in teacher-directed discussion of scientific inaccuracies	• Expresses measured and calculated quantities to precision

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS
D. ANALYZING

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
• Correctly identifies patterns within the data	• Assesses patterns and trends that are conceptually presented by the data	• Assesses patterns, trends and simple relationships	• Assesses patterns, trends and relationships resulting from collected and manipulated data
• Identifies, with teacher assistance, relationships	• Identifies simple cause and effect relationships	• Identifies cause and effect relationships	• Identifies the sources of error in data collection and manipulation
	• Identifies, with teacher assistance, the sources of error in data collection and manipulation	• Identifies the sources of error in data collection and manipulation	• Expresses accuracy qualitatively and/or quantitatively (percent difference), where applicable • Identifies the assumptions relating to measurement and/or analysis
	• Identifies, with teacher assistance, the effect of errors on results	• Suggests amendments to procedures and/or data manipulation in order to rectify results	• Determines the reliability of the data

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS
E. CONNECTING, SYNTHESIZING AND INTEGRATING

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
• Provides a simple but not necessarily appropriate answer to the problem investigated based on results obtained	• Provides a simple answer that is appropriate for the problem investigated and results obtained	• Provides an appropriate answer to the problem investigated based on results obtained	• Provides a qualified answer to the problem investigated
	• Attempts to relate results to knowledge that is not specifically related to scientific theories or laws	• Relates results, with teacher assistance, to applicable theories and/or laws	• Relates the data to laws, principles, models or theories identified in background information and/or in broader context
			• Proposes and explains interpretations or conclusions • Develops theoretical explanations

CRITERIA FOR ASSESSING SCIENTIFIC PROBLEM-SOLVING SKILLS

F. EVALUATIING THE PROCESS OR OUTCOMES

LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
• Attempts to explain results to the problem investigated	• Attempts to explain results to the problem investigated	• Is able to explain the results obtained in light of the problem being investigated	• Evaluates the prediction and concepts	• Restricts, revises, or replaces an unacceptable scientific concept
	• Attempts to draw conclusions where applicable and when prompted	• Draws conclusions and attempts to explain them	Draws conclusions and attempts to explain them	• Establishes criteria to judge the design, prediction, and concepts
		• Discusses the limitations of the data collected, interpretations, and/or conclusions	• Identifies limitations of the data and information, interpretations, or conclusions, as a result of the design of the experiment, research, or project	• Considers consequences and perspectives • Evaluates assumptions and effects of bias
		• Discusses, when prompted, the validity of results Discusses, when prompted, alternatives and/or improvements to the experimental design	• Suggests alternatives and considers improvements to experimental technique and design	• Evaluates the total investigation in terms of reliability and validity

INDIVIDUAL STUDENT PROFILE FOR: ______________________________

Recording:

Record the level of achievement (at least four times using a minimum of one activity from each unit) demonstrated by the student on each of the six components. This is to be done over a series of activities, (assignments, reports, laboratory exercises, etc.) that contribute to the overall development of problem-solving skills.

Determining Levels:

At the conclusion of the course, assign the highest level that the student has demonstrated at least three times for each of the six components.

PROBLEM-SOLVING COMPONENTS	OBSERVATION 1 Level				OBSERVATION 2 Level				OBSERVATION 3 Level				OBSERVATION 4 Level				OBSERVATION 5 Level			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Initiating and Planning																				
B. Collecting and Recording																				
C. Organizing and Communicating																				
D. Analyzing																				
E. Connecting, Synthesizing and Integrating																				
F. Evaluating the Process or Outcomes																				

EVALUATING INDIVIDUAL STUDENT PERFORMANCE BASED ON ASSESSMENT OF PROBLEM-SOLVING SKILLS

This assessment model provides a framework for clarifying criteria against which to judge students' achievement and thereby enable students to raise their achievement in scientific problem-solving skills. The information obtained provides a means for diagnosing students' difficulties and illustrating means by which students can progress toward the course objectives in problem-solving skills. The overall performance of a student over the term of the course will provide a profile from which a grade can be assigned. Upon successful validation of this model, it can be used at the grade twelve level to provide a student mark in problem-solving skills that can be included in the overall grade assigned to the student by Alberta Education.

The levels of problem-solving skills recorded for each student need to be converted into a mark. It is proposed that 20% of the final grade in the course be allocated for the problem-solving skills component.

One possible means of generating this mark is based on two premises.

a. Students in any Senior High academic science course (10, 20, or 30-level course) should achieve at level four in each of the six components by the completion of the course.
b. Students' marks should cluster initially around multiples of 5 (five possible achievement scores) for a maximum of 20 marks. Values between the clusters can be assigned with teacher discretion.

20 marks

The student has attained level 4 for all six components.

15 marks

The student has attained at least level 4 for a minimum of three components, and level three for the rest.

10 marks

The student has attained level 3 for all six components.

5 marks

The student has attained level 2 for all six components.

0 marks

The student has attained level 1 for all six components.

The standards described for each score are suggested, and need to be validated by classroom teachers. This scheme requires teacher judgment with respect to assessing the student's performance against the criteria statements.

SCIENCE PROBLEM-SOLVING SKILLS

MARK ASSIGNMENT GUIDE

$\boxed{20}$ All components at level 4

$\left.\begin{array}{r}19\\18\\17\\16\end{array}\right\}$ Teacher discretion

$\boxed{15}$ Three components at level 4, three components at level 3

$\left.\begin{array}{r}14\\13\\12\\11\end{array}\right\}$ Teacher discretion

$\boxed{10}$ All components at level 3

$\left.\begin{array}{r}9\\8\\7\\6\end{array}\right\}$ Teacher discretion

$\boxed{5}$ All components at level 2

$\left.\begin{array}{r}4\\3\\2\\1\end{array}\right\}$ Teacher discretion

$\boxed{0}$ All components at level 1

CLASS PROFILE

PROBLEM-SOLVING COMPONENTS:

- **A.** Initiating and Planning
- **B.** Collecting and Recording
- **C.** Organizing and Communicating
- **D.** Analyzing
- **E.** Connecting, Synthesizing and Integrating
- **F.** Evaluating the Process or Outcomes

Record the highest level a student has achieved at least twice over the term of the course for each of the six components.

STUDENT NAME	PROBLEM-SOLVING COMPONENT						OVERALL ASSESSMENT (out of 20%)
	A	B	C	D	E	F	

TEACHER'S SIGNATURE: ____________________ DATE: ________________

Appendix I

Appendix I

Communication Modes/Opportunities

The following processes, events and documents were important for communication that informed inservice planning and provided needed information to the field of Alberta educators and administrators affected by or directly involved in the Senior High Science Curriculum field validation and implementation.

Alberta Education with Alberta's Secondary Science Teachers & Administrators

- initial inservice needs assessment - meetings around the province (400 participants)
- Notes on Teacher Inservice Needs, Delivery Systems, Resources and Organization of Professional Development Activities Needs Identified at Zone Meetings - November 1990 (Appendix I)
- suggested Responsibility Sharing for Teacher Inservice chart used in early mail outs and initial curriculum development sessions - April 1991(Appendix I)
- information sessions held around the province in the spring of each year (400-800 participants per year)
- *Field Validation and Implementation Reports* - detailed report on project mailed each year to all schools/school jurisdictions
- Senior High Science Program Implementation - Information and Suggestions for Administrators - February 1992 (Appendix I)
- Suggestions for Teachers Implementing Science 10 - February 1992 (Appendix I)
- Meeting the Challenge - February 1993. (Appendix I)
- regular project reporting in *INFOCUS* the Alberta Education publication distributed to all schools
- resource lists and implementation suggestions for teacher and administrators passed out at information sessions and later mailed to all schools/jurisdictions in the June packages - also available upon request.
- Science Council Conference - Alberta Education Science Team display booth, presentations and information packages provided at the fall conference over the three years of field validation
- Science Team member acted as the Alberta Education representative (liaison) on the Alberta Teachers' Association Science Council Executive
- Alberta Teachers' Association Regional Teacher Conventions in the spring of each year - presentations were provided upon request
- several updates on the post secondary acceptance of Science 30 were sent to school principals and superintendents to be distributed to teachers and student counselors.
- formal meetings and submissions from the Alberta Teachers' Association on the new senior high science program. e.g. Secondary Science Curriculum Circle Report (Appendix I)
- formal survey on professional development needs conducted by Alberta Education and the ATA (1994)
- unsolicited letters/faxes from educators and informal conversations with educators (on-going)

Alberta Education with Field Validation Teachers/Administrators

- teacher journals kept at all inservice sessions and submitted for consideration by the Science Team
- formal feedback forms submitted by teachers on draft student resources and programs of study provided comments that also informed aspects of inservice & implementation planning
- project updates sent to principal/copies of communications to contact teacher sent through the principal to assure administrators were aware of the field validation process and progress

- specific issues such as updated information for student counseling in regards to the new science programs were addressed in direct letters and information packages to principal/teachers and school counselors
- a contact teacher was designated in each school - telephone/fax/teleconference contact
- regularly scheduled teleconferences with contact teachers - sample schedule (Appendix I.) individual teachers were encouraged to phone, fax or write directly with questions/concerns/ideas
- fax communications and letters exchanged to allow for responsive inservice planning and for teachers to make their individual workshop choices before major inservice sessions
- a project newsletter called *Connections* was produced - two issues in the first year - to help establish project identity and inform teachers of various supporting initiatives in project schools. (Appendix I)
- inservice and call-back sessions - field validation teachers have formal and informal opportunities for direct conversations with Science Team members - (5 days inservice, one day callback in Year One, 4 days inservice and no call back day in Year Two and Year Three of the project)

NOTES ON TEACHER INSERVICE NEEDS, DELIVERY SYSTEMS, RESOURCES AND ORGANIZATION OF PROFESSIONAL DEVELOPMENT ACTIVITIES NEEDS IDENTIFIED AT ZONE MEETINGS

An important component of zone meetings was to discuss ways for teachers to deliver the new science programs. Eight meetings were held in the six zones of the province and discussions held with 250 teachers, administrators and members of the science education network. Participants addressed the following: professional development needs, appropriate delivery systems, resources, organization of professional development components of the teacher's resource manual and the ideal learning environment.

The following is a summary of the comments and discussions pertaining to each.

Professional Development Needs

a Broadening Science Expertise

- develop more discipline expertise for Science 20/30
- university graduate courses
- refresher courses in science and lab skills in disciplines

b Instruction Strategies

- develop skills for delivering the new approach
- become aware of the Junior-Senior High continuity
- what is the specific course content in the specific units
- develop methodologies for essential labs
- develop STS connections
- develop new evaluation methods,especially for written work
- develop teaching strategies for group work, problem solving and development of learning skills
- learn how to use a science lab

c Resources

- become aware of appropriate resources
- become aware of what facilities are needed to deliver the new courses
- help with materials for ESL classes
- share costs between rural schools to reduce costs
- inservices sponsored by industry and corporations
- a list of teacher resources for Science 10/20/30

- texts available early
- a good TRM so only limited additional materials are needed
- a contact person to help with problems
- more A-V resources including software
- TRM on computer disk
- up-to-date information resources
- the equipment needed to deliver courses should be available early
- Alberta Education to fund inservice, including university courses
- computer networks - ASPEN
  - electronic science bulletin board
  - teacher network
- synopsis of new research and information on subject matter
- provide appropriate resources in advance of inservice
- inservice by video - ACCESS
- sets of lesson plans available for teachers - particularly for Science 20/30
- packages of unit/lesson plans prepared by teachers for teachers
- lesson plans for teachers outside the science area
- student-oriented resource packages

d. Personal Development, Recognition, Rewards

- reinforcement for good work
- ongoing inservice
- professional development is a professional responsibility
- release time to share information, ideas and strategies
- receive professional development materials before the inservice
- direct professional development to teachers, not administration
- need a drawing card, something that will attract teachers
- teacher expectations must be outlined
- can role model excitement of learning as teachers learn the new courses and deliver them
- teachers undergo lifelong learning too

e. Awareness Issues

- ongoing commitment by Alberta Education to vision
- professional development for administration in philosophy of science courses
- professional development for business and industry communities on nature of courses
- professional development for school guidance counsellors
- communicate the objectives of the programs to the boards and parents

f. Professional Development Delivery

- modular units to bring teachers up to speed in disciplines, perhaps by distance education through Athabasca University
- pay for substitutes for county inservice
- summer courses offered at regional centres or colleges
- have one professional development with pilot year teachers as resource people
- to role play STS study approaches and teaching strategies, problem solving strategies and active learning
- three-day workshops in Science 10

CB: 90 11 27 (INSERVICE)

g Personnel - To Conduct Professional Development

- specialists within school
- specialists in general science
- pilot teachers
- guest speakers
- industry representatives (resource persons for STS)
- Alberta Education personnel
- ATA Science Council
- Peer support network between teachers in a school or a division

Organization of Professional Development

a Type of Activity

- experience the new teaching approach as students
- simulated situations-unit-specific strategies for instruction and development of subject matter
- peer coaching
- university credit courses - to upgrade specialists (summer courses)
- 3-credit courses offered by science faculty
- 3-credit courses offered by education faculty
- courses in series e.g. biology, chemistry, physics and CI
- community colleges to deliver professional development (2-week courses in the discipline delivered by community colleges)
- Alberta Education roadshow on specific units
- three-day conferences on specific courses in science, biology, chemistry and physics
- pyramid system of inservice for leadership (cascade model)
- summer institutes - one for each course
- SEEDS - Shell Merit Award model
  - forum
  - experts in the field
  - seminars
- professional development team from Alberta Education to visit each school
- three to four day professional development with pilot teachers to develop an implementation plan and become familiar with courses
- special presentations to school boards and parents to explain program philosophy
- extra prep time during implementation year (time to think)
- weekends with industry sponsored workshops
- P.D. days - teacher conventions
- professional development by video - (ACCESS)
- summer programs-field trips, business, industry, geographical areas (regional delivery?)
- release time for sharing information and strategies

b Frequency of professional development activities

- many opportunities for teachers to get together to share information and strategies
- one or more sessions (summer institutes)
- long lead time for preparation and planning
- ACCESS for ongoing activities

c Scheduling of Professional Development Activities

- one professional development during field test year; one before implementation and one during implementation year
- early in the school year
- last week of school in June-diploma time (January)-prefer during the regular working day
- convenient geographic location
- undercharged within the school day (extra prep time for planning the new program)
- various times - weekends with industry
- summer and ongoing
- in August - to keep fresh in mind
- more PD days during the year

Teacher Resource Manual (TRM)

a Format

- three-ring binder to facilitate updating (put on computer disk for distribution)
- Science 14/24 TRM is a good model
- close relation to the course content
- close relation to the textbook
- self-contained document that would provide for success first time
- TG for text and TRM should be integrated
- put on computer disk for distribution

b Planning to Teach

- expanded objectives stated (teachers should know what the exam makers know)
- identify interface of biology - chemistry - physics
- sample lesson plans
- sample unit outlines
- suggested timelines for each unit
- STS background

c Teaching Strategies

- activities
- demos
- identify alternative learning strategies
- STS enhancements
- variety of activities for a particular concept

CB 90 11 27 (INSERVICE)

- recommended laboratory activities
- compile ideas from pilot teachers and others
- field trip ideas
- lists of contact people (speakers and tours)
- list plenty of alternatives
- sample worksheets
- generic lesson plans showing STS integration

c Teaching Resources

- must be updated regularly, e.g. "evergreen"
- lists of films and videos (classified by topics)
- lists of computer software
- bibliography of books, periodicals, articles
- alternative labs and demos
- lab safety information
- lab suggestions (e.g. when to start growing plants)
- list of library resources
- emphasis on STS resources
- sources of materials & equipment
- directory of services
- detailed answers to text questions
- sample lab data
- detailed instructions for the preparation of lab solutions
- enrichment materials
- remedial materials
- project outlines
- current STS materials
- more detailed teacher guides from publishers
- list additional sources of support material

e Evaluation

- examples of evaluation
- test item bank for each course
- sample evaluation for subjective scoring (written reports, notebooks)

f Other Concerns

- ALL resources (including TRM) must be in place before implementation

The Ideal Learning Environment

- modern equipment and facilities; budget for upgrading as needed
- combined laboratory-classroom or laboratory separate from classroom
- prep room adjacent to laboratory
- facilities for storage and disposal of hazardous substances
- plenty of space for doing activities and for storing equipment
- a computer and software
- lab assistants

CB: 90 11 27 (INSERVICE)

- accessible to the handicapped
- adequate library resources
- safety features
- manageable class sizes
- greenhouse
- regional "fix-it" centre
- money to buy equipment
- flexible access to equipment within schools
- redesign of facilities to suit new programs
- A-V equipment station
- itinerant resource people hired to bring ideas that work into school
- high-tech delivery of course material
- computer simulations for labs
- release time, lightened teaching load during first part of implementation
- built-in air tables, hydroponic facilities, darkroom
- lab space may not be available for all courses
- flexible lab and class space for active learning

PARTICIPANTS	INSERVICE ACTIVITIES
ALBERTA EDUCATION Curriculum Branch Student Evaluation Regional Offices ACS Language Services	Directly responsible for organizing: - inservice of field test teachers - orientation sessions for school system representatives Presenters, by request: - at professional development workshops - teachers conventions - ATA Science Conference
SCHOOL JURISDICTIONS	Directly responsible for organizing: - inservice of system science teachers - professional development days - networks among science teachers
ALBERTA TEACHERS' ASSOCIATION	
P.D. Executive Staff	Provide advice and assistance in planning professional development programs
Convention Association Boards	Organizes teacher's conventions
ATA Science Council	Organizes annual ATA Science Teachers' Conference Promotes regional networks among science teachers
Local Associations (school staff)	Involved in organization of professional development days
OTHER Postsecondary Institutions Business and Industry Professional Associations Government Agencies	Directly responsible for providing: - pre-service education of science teachers - extension courses for practicing science teachers Additional offerings could include: - summer workshops - summer work programs - resources for summer institutes - scholarships - partnerships with schools

CB 91 04 08 (RW Sci-Inservice Structure)

SUGGESTIONS FOR TEACHERS IMPLEMENTING SCIENCE 10

Be Patient with Yourself

The implementation of Science 10 and all the new science programs is a long term project. It can't all be done in the 1st semester or first year you teach Science 10. Be patient with yourself, reflecting and revising as you go along. Remember that the "life-long learning" process applies to teachers as well as students.

Establishing the Vision

Use the three background documents, the Teacher Resource Manuals and Senior High Science Video series, Programs 1-5, as a starting point to establish a clear vision of the major program initiatives:

Teaching for Thinking
STS Teaching Strategies
Focus on Research/Communication Skills
Cooperative Learning Strategies
Broadened Assessment/Evaluation Strategies
Learning Cycle (Planning)

Administrative Support

Seek administrative support at the school and jurisdiction level by assuring the appropriate people are aware of the nature and extent of the changes in the new science curricula and the availability of the resources that support them.

Request consideration of the implementation of Science 10 and subsequent science courses when the timetable and budget are planned. Ideally preparation times can be planned in a manner that supports cooperative planning and implementation of Science 10.

Participate in long-range planning for improvements in science facilities and equipment.

Student, Parent and Community Awareness

Incoming grade 10 students, their parents and the community require information on the new Science 10 course and the new science programs that follow. The post-secondary possibilities of the Science 10-20-30 program and the discipline 20-30 level courses need to be clearly understood and communicated by teachers, counsellors and administrators to students and parents. Several possible routes exist for students at the 20 level. The science courses each school will offer and each student will take must be determined on the basis of the needs of that particular school or student.

An Alberta Education brochure is being prepared to help introduce Science 10. This brochure will be available in the spring of 1992. Baking Better Science, Program 1 of the Senior High Science Video Series is available through ACCESS and can be used with parents and students and school staff.

Community Involvement/Partnership Possibilities

Tap into community resources to accomplish program objectives - field trips, speakers, information packages. Formal or informal partnerships can provide more for a more effective and motivating program delivery, bringing science and technology and science related social issues alive for your students.

CB 92 02 26 (MB/BR Misc.Teach)

Peer Coaching/Upgrading

Share your expertise in your discipline(s) with other teachers and tap into their expertise in areas where you require assistance. Use the recommended background resources in biology, chemistry, physics and Earth Science to provide support in your area of weakness. Look at the possibility of enrolling in upgrading courses to give you a broader background in science and/or new methodologies.

Professional Development Opportunities/Leadership

Take advantage of professional development opportunities within your school, jurisdiction, convention zone and ATA Science Council Conference. Provide leadership whenever possible, pass your particular strengths on to others - e.g., science discipline expertise, cooperative learning, skills assessment, exemplary field trips, STS teaching strategies, teaching to themes. The Senior High Science Inservice Module package provides 13 module templates for PD workshops on major program initiatives as well as a list of Alberta educators prepared to offer workshops on these initiatives.

Teacher as Facilitator

Analyze your current teaching style to determine where you are on the continuum from the more "traditional" model to the "teacher as facilitator" model. Determine what is a reasonable goal for modification of your current style during the first round of Science 10. Be realistic and take one step at a time.

The Team Approach

Create networks with other science teachers and work as a team on the planning and implementation of Science 10. The "team approach" does not mean fragmenting Science 10 into units with a different teacher taking each unit. It means each teacher doing the whole course while closely networking with the rest of the science staff. If you are alone in your school reach out electronically through the ATA BBS, or personally through contacting neighbouring school teachers in your jurisdiction or other jurisdictions. Try to find at least one planning partner.

Consider the possibility of working directly with the librarian, an English teacher and/or a social studies teacher, particularly on library research assignments and science related social issues. Can students become involved in activities which satisfy the requirements of both courses and have both teachers reinforcing the skill and concept development which is common? An added benefit can be the sharing of assessment and evaluation tasks.

Theme Framework/Interdisciplinary Approach

Use the themes of *Energy*, *Matter* and *Change* as a planning framework to make connections within and between units. Focus on the "big ideas of science" rather than the discipline sciences as separate entities.

STS Connections/Resource Rich Environment

The STS connections column in the course of studies is a bit different than the knowledge and skills columns. STS connections are essential but the examples provided are suggestions only. The STS connections in the course of studies are covered in the basic student text. However teachers are encouraged to adapt the STS connections to best suit the needs of their students, dealing with local or community examples, issues or field trips or any of the current global issues.

Newspapers and periodicals as well as a vast array of authorized and other support resources can be put to good use in the classroom. Refer to the extensive resource lists near the end of the two teacher resource manuals. Several resource agencies listed there provide free resources which directly support the new curriculum. (Note: Significant revision of the resource lists is occurring from the 1st draft, June 1992 edition.)

Establish a hanging file for clippings on various STS topics and add to it as you go along. Any article written by an Edmonton Journal writer may be duplicated for classroom use. Check with your local newspapers for copyright clearance information.

Be Aware of the Junior High Science Program/20 Level Science Programs

The concepts, skills and STS connection charts to be distributed in the spring of 1992 will be helpful in this respect. It is important to know what background the students are arriving with and what the expectations for the next level of sciences are. This information helps in planning and determining the depth of coverage. Programs of Studies for all these programs are included in your information package to assist you with your planning.

Where are the Students At?

Determine the depth of student knowledge and skill before launching into new topics. Do not assume the students are starting from ground zero. Find out where they are at and build from that point. This will assure you spend time effectively and avoid the boredom factor.

Broaden Assessment and Evaluation Strategies

The course of studies is the guide for what is to be assessed and evaluated. Student expectations have been broadened to include more focus on skills and STS connections. Assessment and evaluation strategies must broaden to address these areas. Use the teacher resource manuals and your own experience to help map out an appropriate course assessment and evaluation plan.

This challenge is best met through careful pre-planning, and gradual transition. Determine where you and your colleagues are on the assessment and evaluation continuum and set a plan with realistic goals. Work the "bugs" out as you go along, revising the plan as the course proceeds.

Students and parents should be provided with an outline of the course assessment and evaluation plan. Individual assignment assessment and evaluation criteria should be available to students when assignments are set to clarify your expectations. Student self-assessment can be a powerful learning tool for students and can lighten the burden of marking for teachers.

A group of experienced item writers and field validation teachers are currently involved in a project to create exemplary unit and final exams for Science 10 and Science 20. The item bank for Science 10 is growing and now available on disk from Alberta Distance Learning Centre. LXR Test software which currently is available only on the Macintosh platform is required to access the item banks. An information sheet on LXR Test is included in your package.

Skills assessment and evaluation instruments and strategies are also being developed by a teacher team.

Equipment and Facilities

Become actively involved in the long range planning for facilities and equipment within your school/jurisdiction. Consider the *Vision of the Science Classroom for the 21st Century* document as you proceed. In the meantime use what you have in the most effective manner possible. You may be amazed at what treasures lurk in science store rooms and cupboards. Take a complete inventory of what is available in your school and go from there. Use your creativity to substitute for equipment you may not have. Substitute alternative activities which you have equipment for or can easily obtain or have students construct needed items for you. Consider setting up single stations of several activities and rotating students through them to avoid large purchases. Involve students in providing or constructing equipment as far as possible. Do not order everything on the Science 10 equipment list as you certainly will not do every activity in the *Visions 1* book. Select activities with the program requirements and your particular inventory of equipment and supplies in mind.

Integration of Technology

Explore the possibilities of integrating or extending the present use of computers in planning and preparation, record keeping, reporting, test generation, graphing and monitoring for classroom activities and word processing for student assignments.

Encourage the installation and use of a modem for networking with other students and teachers across North America and the world.

Upgrade your computer skills as required but in the meantime tap into student expertise in the computer area.

Plan/extend the integration of laser videodisc technology. Laser discs with curriculum fit are being considered for authorization as support resources for the new programs.

LXR Test is a powerful test generating and marks program on the Macintosh platform. It is the program being used by Alberta Distance Learning Centre for the creation and sharing of item banks in all subjects. The search for a comparable and/or compatible program on the PC platform has proved unsuccessful to this point. Copies of the items in the Science 10 bank can be provided on disk in LXR-Test format from LRDC.

The Course of Studies is Your Guide

Use the Science 10 Course of Studies and not the Visions 1 student text to provide the definition of what is to be taught. Select activities from text to accomplish the course goals - additional activities, questions, extension, and enrichment material is included in the text. Do not attempt to cover all the material in the text book.

Unit Sequence

The recommended order of unit coverage for the first time through is Unit 1, 2, 3, 4. There is a sequential building of concepts and skills from unit to unit. This order may be modified but it requires extra effort in the planning phase. The goals of the program can be accomplished without using the unit framework at all and by teaching to a selected theme or two. The total theme approach which abandons units requires more intensive planning to assure the program goals are accomplished. We encourage those teachers with the desire and energy to accomplish such a task to give it a try. Should you take on this challenge we would appreciate it if you would keep in touch with us regarding your approach and progress. We are prepared to support you in your efforts.

Establish Timelines

Establish timelines for each unit, to accomplish course objectives. Plan lessons with that time line in mind and adhere to your plan. Focus on the themes, skill development, and an STS context as the vehicles for concept development. Avoid the trap of too much detail. Refer to the junior high program and the 20-level programs to help determine depth of coverage. Remember the Visions 1 test provides for choice, enrichment and extension so pick and choose to accomplish the course within your timelines.

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SENIOR HIGH SCIENCE PROGRAM IMPLEMENTATION

INFORMATION AND SUGGESTIONS FOR ADMINISTRATORS

Common Goals Across the Curriculum

Many of the new science program initiatives are similar to initiatives in other subject areas. Teaching for thinking, integration of technology, development of communication skills, cooperative learning strategies and broader assessment and evaluation strategies are but a few of the common elements.

Explore the possibilities of having teachers from different areas working together to accomplish curricular objectives of two or more programs.

Professional development activities can be applicable to several curricular areas and can be offered in a manner to encourage cooperative planning and teaching across the curricula.

Program Awareness

Increase awareness of the new senior high science program implementation and particularly awareness of Science 10 within the school and the community.

- Programs of Studies (latest drafts) for all courses expect Science 14-24 (previously implemented) will be mailed to all schools and jurisdictions in March, 1992.
- Use the Vision Statement found at the beginning of all programs of studies as a framework for presenting the changes to staff and the community.
- A brochure on Science 10-20-30 for use with the community will be available in April, 1992.
- ACCESS "Senior High Science Video Series". Programs 1-5 provide needed information on the nature of the changes to the science programs. (ACCESS order #BPN3022.) Program 1 $9.25, Programs 2-5 $42.25.

Program 1, Baking Better Science, can be effectively used in presentations for potential students and/or their parents. It can also be used to introduce the Science 10 program to the school staff as a whole.

Programs 2-5 are science teacher inservice videos which answer teachers questions about the new program directions and provide models for teaching in a Science, Technology and Society context.

Resources

Vision 1, the custom developed student text and the accompanying teachers guide, are both **basic** resources available through LRDC. The standard 25% discount for basic resources applies and the $15.00 per pupil credit provided by the SEICAG grant can be applied to these resources.

		List Price	25% Disc.	SEICAG Applied
Visions 1 Student Text	LRDC #OSC10130	$52.45	$39.35	$24.35
Visions 1 Teachers Guide	LRDC #OSC10129	$52.45	$39.35	

Provide your Science 10 teachers with the Senior High Science Teacher Resource Manual and the Science 10 Teacher Resource Manual available through LRDC, June 1992.

Science 10-20-30. Who is it for?

Assure that your teachers and counsellors have correct information as to the nature and acceptance of the Science 10-20-30 program and the Biology, Chemistry and Physics 20-30 programs.

Science 10-20-30 provides an advanced diploma route and can fulfill the science requirements for a wide array of programs at post-secondary institutions (refer to the information sheet in your package).

Science 10-20-30 is an academically rigorous program with challenge equal to that of any of the discipline sciences. It is an interdisciplinary science program with a diploma exam and is not designed to be a remedial science program. The Science 14-24 program is the remedial program available to those students who have experienced difficulty in junior high science and/or mathematics. Consider timetabling Science 10 and Science 14 in the same block to allow for easy movement of misplaced students early in the course.

Students taking Science 10-20-30 program will gain a broad and connecting background in science which can, depending on the students' future plans, provide a better background than any one, or even two, discipline sciences can.

Schools will need a comprehensive counselling plan to assist students in making choices as to the various 20-level science courses available. Make sure the information provided is current and correct.

What Science Programs will we offer?

Every school will have to make the decision as to which 20-level science courses they will offer. This decision will be based upon a number of factors such as:

- school population
- budget/resources available at the school (teachers/Facilities)
- general student body career aspirations and individual student career aspirations
- parents/community knowledge and understanding of the new programs as related to student need
- how distance learning programs fit into the plan

Long Range Planning/Budgeting

Take the implementation of the science programs into consideration when long range planning and setting budgets.

Become familiar with the *Vision of the Classroom of the 21st Century* document and the equipment and supply requirements for the various programs (included in the information package). Consider the "Vision" when planning additions or renovations to science facilities.

Encourage teachers to take a full inventory of equipment and supplies already in the school and carefully consider what activities can be done with the equipment at hand. Discourage the ordering of everything on the equipment list. Encourage creative substitution.

Library research in science related areas will require current reference material in school libraries. Refer to the support and other resource lists in the teacher resource manuals for suggestions. Selected periodicals and newspapers can feature strongly as support resources in the science area. A suggested science periodicals list is available from the Regional Offices of Education upon request. (Science Education Consultants.)

The high activity orientation of all the new science programs demands a lost of set-up and clean-up time. Laboratory assistance for the science areas is a great asset and should be a consideration in budgeting and planning.

Integration of Technology

The focus on the integration of technology into the science classroom has implications for long-range planning. Is it possible to plan for networked computers to be part of the equipment in every science classroom and teacher preparation area?

Can a modem be installed to allow teachers and students to network through the ATA BBS and other computer networks?

Can LXR-Test or a similar program be purchased to make test generation and marks and record keeping an easier task?

LXR-Test is a powerful test generating and marks program on the Macintosh platform. It is the program being used by Alberta Distance learning Centre for the creation and sharing of item banks in all subjects. The search for a comparable and/or compatible program on the PC platform has proved unsuccessful to this point. Copies of the items in the Science 10 bank can be provided on disk in LXR-Test format from LRDC.

Can laser videodisc players and discs be worked into the budget?

Science tool kits for classroom use are being tested and authorized for the new programs - can they be budgeted for over time?

Distribute the Challenge

Where it is possible the challenge of teaching Science 10 should be shared and not carried entirely by one teacher. Teacher with expertise and/or experience in one discipline should be encouraged to teach Science 10 and become aware of the foundation course to their particular discipline.

Again teams of teachers working together seem to be the key. Where schools are small and only one teacher is handling the sciences, help that teacher establish networks with teachers in other schools so they are not working in isolation.

Timetabling Considerations

Dilemma

Teachers implementing Science 10 and all new science courses will have an increased preparation and marking load. The courses have a high activity orientation and teachers are encouraged to broaden assessment and evaluation strategies beyond the paper and pen examinations. They are asked to become facilitators of learning, using more cooperative learning strategies and placing more responsibility for learning on the student. Library research projects are a part of the program as well as a focus on the development of communication skills in the science context.

Possible Solutions

Team planning has emerged as an effective technique for the implementation of Science 10. If teacher teams are possible, at least two, and ideally three, teachers of different discipline background could have preparation periods at the same time. This allows for cooperative planning and consultation. Where field validation teachers were not given common preparation time, or worse yet no preparation time, the stress took its toll on teachers and students.

Community Partnerships/Field Trips/Speakers

The STS context of the new science programs provides ample opportunity for teachers and students to reach out into their communities to provide real life context for science, technology and science related social issues.

Such initiatives take time and commitment on the part of the teacher and require the guidance and support of the administration of the school.

The forming of formal or informal partnerships with business, industry or research agencies again requires administrative support and direction. Such partnerships, if carefully planned and implemented, can benefit the whole school community.

Class Size

When determining class sizes consider the high activity orientation of all the new science programs and the safety and teacher effectiveness factors that relate to that class size. The broadening of assessment and evaluation strategies again relates directly to class size.

Evaluation of Teachers

When evaluating teacher performance in the classroom be fully aware of the new program directions. Expect more activity and noise in the room. Do not be taken aback by a debate or role play on a science related social issue. Refer to the *Senior High Science Teacher Resource Manual* Section 2 - Vision of the Science Classroom into the 21st Century for a possible teacher evaluation checklist and appropriate to the context of the new science curricula.

Meeting the Challenge

Attitude/Pacing

Be Patient with yourself - implementing of a new science program is a long term project.

Set realistic goals and reflect and revise along the way.

Gradually integrate new teaching and assessment strategies into your repertoire.

Cooperation is Salvation!

Work as a team. If alone, seek out other teachers - use the BBS to keep in touch and exchange materials.

Be Prepared

Use the Senior High Science TRM to develop a mental set before planning - it provides information on major program initiatives with examples of appropriate teaching/assessment strategies and a comprehensive resource list.

Use the five specific TRM's for background, exemplars and more specific resource information.

The Textbook is not the Course!

Let the Program or Course of Studies be your guide - the text is a resource.

Select text activities and material with specific program/course of studies objectives in mind; modifying, combining or substituting as appropriate.

Know the Flow

Where are the students coming from and where are they going?
Be aware of the:
- Junior High Science Program
- Science 10 program
- 20-level science programs
- 30-level science programs

Timeline Commitment Critical

Suggested Unit Time Allocations

Science 10	%
Unit 1	20
Unit 2	25
Unit 3	30
Unit 4	25

Science 20	%
Unit 1	20
Unit 2	25
Unit 3	30
Unit 4	25

Physics 20	%
Unit 1	30
Unit 2	20
Unit 3	20
Unit 4	20
Unit 5	10

Biology 20	%
Unit 1	20
Unit 2	15
Unit 3	40
Unit 4	25

Chemistry 20	%
Unit 1	30
Unit 2	30
Unit 3	15
Unit 4	25

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STS Connections - Focus with Purpose

All STS connections cannot be covered to the same depth. Availability of resources and student/teacher interest are important factors in the selection of the STS connections to be emphasized. In planning, assure the connections you select for in depth development provide for significant skill and concept development.

How Far Do I Go? The Depth Issue

- Know the objectives of the courses of study for both the prerequisite and the following course(s).
- Use the program of studies as your guide, not the textbook.
- Be selective in choosing activities and material from texts or other resources.
- Adhere to timelines set for each unit.
- Plan STS connections for maximum interest and efficiency.
- Avoid the temptation in Science 10 of teach to the former Biology, Chemistry or Physics 10 subject depth - two full year courses in the discipline subjects will follow for students pursuing those routes.

Frameworks for Planning

Use the themes to provide connections within and between units and courses - matter, energy, change, diversity, equilibrium, systems.

Use the "Learning Cycle" model as demonstrated in the lesson exemplars in the TRM's.

Consciously plan connections from unit to unit with selected themes, concepts, skills, and STS connections.

Ideas from the Field

Develop the Difficult Gradually

Spread major or difficult concepts and skills across two or more units - this allows for gradual introduction followed by further development and practice, perhaps in a different context. Example, Science 10 - Introduce chemical symbols and writing and balancing equations with photosynthesis and respiration in Unit 1, build in Unit 2, completely develop in Unit 3 and apply to combustion reactions as examples of energy conversions in Unit 4. Example: Science 10, Unit 1 - introduce $Q=mc\Delta T$ qualitatively and follow up in Unit 4 with the quantative treatment.

Two Better than One

In the discipline sciences, teachers have found it useful to have both authorized resources for reference and planning purposes.

Smart Planning

Science 20 and Biology 20 both call for field studies. Several schools found having the field trip for both courses together to be efficient and effective.

Connections

For Science 10 Field Validation Teachers

November 1991

You are more than half way through the first semester of the Science 10 field test! Are you wondering how teachers and students in the rest of the province are doing? What will happen to the Science 10 course of studies and the *Visions 1* textbook in response to your feedback? What are the common and immediate concerns of teachers, and what support can be offered at this time?

Teleconferences, written feedback and school visits have provided us with very useful information. Here is a synopsis of what is happening across Alberta.

STUDENT PERCEPTIONS

Generally, students are responding positively to the new course. The activity orientation and beginning lessons with STS connections work well for them. They have few complaints regarding the student text, finding it easy to read, interesting and relevant. Complaints centred on the loose-leaf format and the weight of the resource.

Students enjoy the shift in teaching/learning strategies but wonder how their mark is to be determined. How will cooperative group work, laboratory skills, discussion skills, debate or research projects figure in their mark? For students, a "mark value" seems important for almost every activity.

Students find Science 10 demands more than the junior high program. Having more responsibility for their learning is tough, but they like the challenge of exploring problems themselves and actively participating in their own learning. Teachers indicate that students who came through the new junior high program are more capable and comfortable with this approach. As well, these students have better laboratory skills when compared with students in previous years.

An article written by Laurence E. Miall, a Grade 11 student at Victoria Composite High School, published in *The Edmonton Journal*, November 3, 1991, has been duplicated and included with this newsletter. Laurence clearly sets out the challenge we all face as we implement the new secondary science programs and grapple with the question, *What is "more and better science" for Alberta students?*?

TEACHER PERCEPTIONS

Course of Studies

Teachers find the Science 10 course of studies allows flexibility in sequencing of topics within units. The course is different, exciting, provides a wide variety of topics, and connects science to the real world. Some are enjoying learning the new background required and find they really appreciate the questions the students are generating. The new program is promoting development of skills in science. Potential to integrate not only the science disciplines but to integrate with other subjects is great. The tie to the science themes of *energy*, *matter* and *change* within each unit is seen as a positive, though teachers have to work with students to discover the connections from concept to concept and unit to unit. Teachers are also finding that the field validation allows them to tryout strategies they may not have used previously.

Time (depth)

Teachers have asked for guidance as to depth for each concept, skill or STS connection. They need to know the level of background required for the 20-level courses.

Several field validation teachers will be called upon in January/February 1992 to develop more specific "student expectations" for the required concepts, skills and STS connections. They will help determine appropriate depth from their experience in teaching Science 10.

Time is often mentioned as a problem, with too many activities and too much material to be covered in the time allowed. There is a conflict between development of the proclearning and innovative projects using to accomplish the required skills, STS connections and attitudes as well as the required concepts

- motivating students and optimizing learning by actively seeking STS connections as a beginning and continuing context for the required science concepts and skills

- using a broader base of evaluation and assessment techniques that reflect the broader goals of the program skills assessment, research project evaluation, student self-evaluation, assessment of contribution to cooperative group learning are being developed or adapted from the teacher's guide, TRM or other resources.

A definite period of adjustment is needed as teachers adapt to new teaching and evaluation strategies. New strategies must be gradually introduced into a teacher's repertoire. Teachers should keep trying new ones and refining them as required, keeping the themes, STS connections and skill development as a focus.

Teachers should use the teacher's guide and the TRM for STS ideas, sample activities and evaluation strategies. Tap into examples in the student text, newspapers, periodicals, television, and the local community. Contexts that interest teachers and students, and offer opportunities to advance the curriculum should be chosen. Teacher interest and enthusiasm can be contagious! The student text in an STS course will never be a stand-alone but offers a starting point. The course should evolve to include local, timely and relevant issues that will change from semester to semester, or even from day to day.

When broadening evaluation and assessment repertoires try to include student self-evaluation checklists for cooperative learning group work, process skill assessments, project and presentation evaluations, and STS connections on quizzes and unit tests. Developing a student portfolio reflecting progress in the knowledge, skill, STS connections and attitude areas becomes the challenge. Use the teacher's guide and the TRMs for ideas, models and checklists for all kinds of activities, including student self-evaluation.

ITEM BANK DEVELOPMENT

The Mac!

The Science 10 Item Bank is currently under development, thanks to those who are helping with submissions. The items have been passed on to Alberta Distance Learning Centre for entering and editing. Desiree Hackman has sent packages to the contact teachers, containing hardcopies of the submissions, including some course outlines, unit outlines and worksheets. It is hoped teachers find them useful and continue to submit to Desiree any materials that will help this project get rolling!

JANUARY INSERVICE SESSIONS

At these sessions the changes to the Course of Studies, student text and the teacher's guide will be discussed. Teachers will also be given opportunities to share their experiences and indicate future plans on delivering Science 10 to their students. Further information will be made available soon.

JUNE INSERVICE

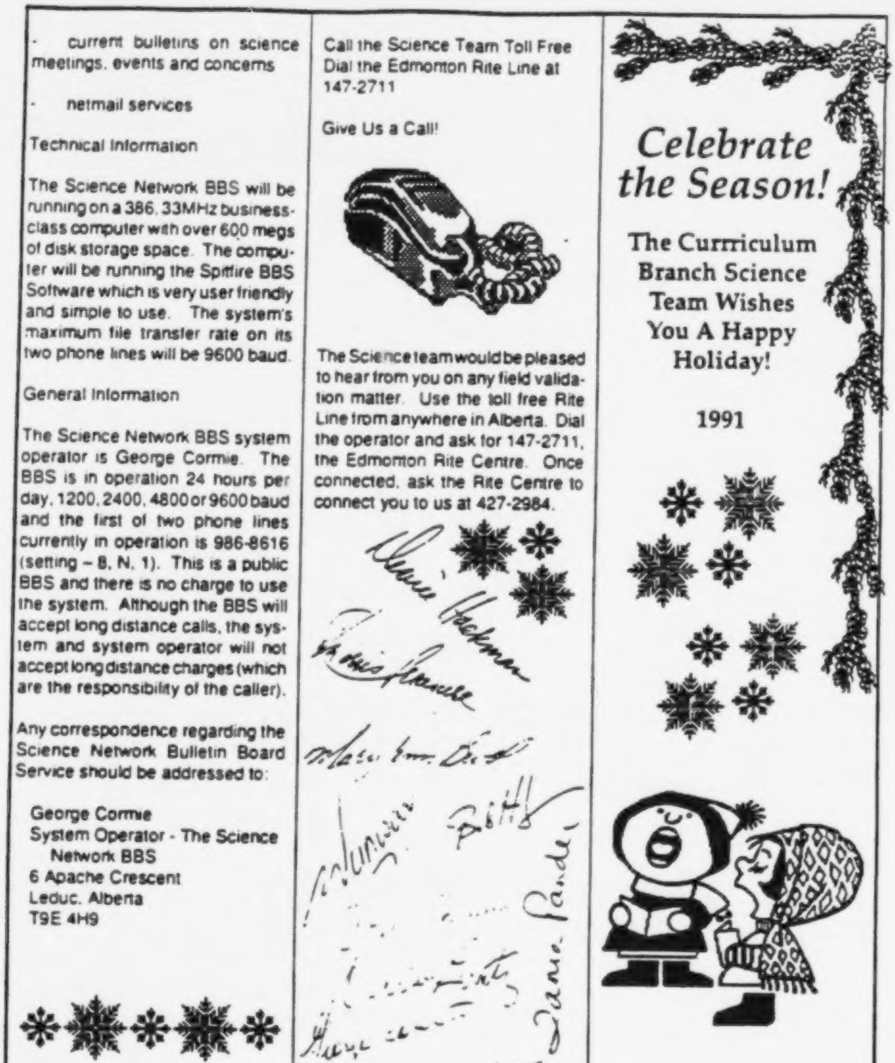
The science team will be meeting with representatives of jurisdictions to help plan the scope and nature of the inservice. As soon as this advice is received participants will be advised of the plans

UPDATE: STATUS OF SCIENCE 30 - ENTRANCE TO POST-SECONDARY INSTITUTIONS

University of Alberta, Faculty of Science

The Faculty of Science forwarded the following recommendations to the Committee on Admission and Transfers. This committee approved the recommendations of the Faculty of Science in November and will forward its recommendations to the General Faculties Council (GFC) for approval. Other faculties need time to reassess their admission requirements. We can expect resolution on Science 30 in the Spring of 1992. Other faculties will also be making recommendations regarding Science 30, and these recommendations will also be forwarded to the GFC for final decisions. The following has been reprinted by permission from the Faculty of Science, University of Alberta. The *Faculty of Science Express* announced that "**the following recommendations have been approved by the Faculty of Science Chairs**:

1. That the definition of the Science Group (Group C) of admission subjects be changed to include Sci-



- current bulletins on science meetings, events and concerns
- netmail services

Technical Information

The Science Network BBS will be running on a 386, 33MHz business-class computer with over 600 megs of disk storage space. The computer will be running the Spitfire BBS Software which is very user friendly and simple to use. The system's maximum file transfer rate on its two phone lines will be 9600 baud.

General Information

The Science Network BBS system operator is George Cormie. The BBS is in operation 24 hours per day, 1200, 2400, 4800 or 9600 baud and the first of two phone lines currently in operation is 986-8616 (setting – 8, N, 1). This is a public BBS and there is no charge to use the system. Although the BBS will accept long distance calls, the system and system operator will not accept long distance charges (which are the responsibility of the caller).

Any correspondence regarding the Science Network Bulletin Board Service should be addressed to:

George Cormie
System Operator - The Science
Network BBS
6 Apache Crescent
Leduc, Alberta
T9E 4H9

* * * * *

Call the Science Team Toll Free
Dial the Edmonton Rite Line at
147-2711

Give Us a Call!

The Science team would be pleased to hear from you on any field validation matter. Use the toll free Rite Line from anywhere in Alberta. Dial the operator and ask for 147-2711, the Edmonton Rite Centre. Once connected, ask the Rite Centre to connect you to us at 427-2984.

Dennis Hackman

Betty

Celebrate the Season!

The Curriculum Branch Science Team Wishes You A Happy Holiday!

1991

Alberta
EDUCATION

Connections 2

For Science 20 Field Validation Teachers

December 1992

Thanks for Your Feedback!

To date the field validation of the 20-level sciences has gone relatively smoothly. Your perceptions of the courses of study and the resources as received through the nine teleconferences and the validation forms have provided information vital to the revision of both the courses of study and, in the case of Science 20, the student text and teacher's guide. We sincerely appreciate your commitment and the time and effort you have put into providing us with this information. Please keep those forms and comments coming! We encourage and welcome comments and specific suggestions for improvement to either the Science 20 course of study or the field validation draft resources until late January 1993.

Science 20

Course of Studies

Units 1 and 2 of the course of studies have proved satisfactory with no revisions being planned. Unit 3 proved a bit lengthy and is currently being revised by eliminating Faraday's Laws. Unit 4 teleconferences are scheduled for mid-December and we anticipate the arrival of your field validation forms on the Unit 4 course of studies.

Basic Resources (Text and Teacher's Guide)

The *Visions 2* field validation draft and the accompanying teacher's guide are viewed as covering the course of studies adequately and to be at the right reading level. Teachers have made excellent specific suggestions for improvement to chapters within Units 1, 2 and 3, and revisions are now in progress.

The aquatic field study section in Unit 2 is being modified to apply more generally to any freshwater site selected.

Unit 3 will undergo the most significant revision to better match the course of studies; for example, the treatment of the STS connection on fertilizers will be given much less emphasis and Faraday's Laws will be eliminated to reflect this change in the course of studies. The number of chapters in the text for Unit 3 will be reduced from four to three in the final version.

A copy of the revised version of the *Visions 2* text will be provided to all field validation teachers early in the new year.

Depth of Coverage in Unit 3

To provide some assistance in the determination of depth of coverage, chemistry program consultant, Stella Shrum, has developed two charts. One chart deals with Unit 3 in Science 10 and the other with Unit 3 in Science 20. Copies of these charts have been provided to your contact teacher for distribution. Should you have any questions regarding depth of coverage, Stella would be pleased to discuss them with you.

Alternative Approaches

Field validation teachers Rosa Andreiuk and Dawn Davidson of Central High in Sedgewick, Wes Irwin of Grande Prairie Composite and Larry Albrecht of Brooks Composite are using the theme of Petroleum/Oil and Gas as an organizer for teaching Science 20. They report that this approach is working well with their students, and the theme adequately provides for inclusion of the material in all four units.

Field Studies Critical

Field studies of a freshwater and terrestrial ecosystem are an essential component of Science 20, Unit 2. Several contact teachers have reported their field studies have successfully linked learner expectations from Units 1, 2 and 3. These teachers report that the concrete learning context such studies provide make the time spent on these endeavours well worth it. Teachers suggestions include: scheduling trips early in the fall; efficiently combining the aquatic and terrestrial studies within the same area/trip, and combining their Science 20 and Biology 20 classes for the field study.

Tom Koch of Father Mercredi High, Fort McMurray, had his class monitor a town creek that Syncrude no longer monitors. Class results indicated a possible problem with the water quality of the creek. The class contacted the company and provided them with their data. As a result, Syncrude confirmed their results and had the creek put back on the list for regular monitoring and consideration for remedial action.

Students practised monitoring techniques, analyzed their results and experienced a direct application of such monitoring. They can take pride in their action toward preserving the ecological integrity of the creek.

Pauletta Renkema and Nicole Hickle of Lorne Jenken High, Barrhead, collaborated to provide their Science 20 and Biology 20 students with a river field study. Tim Bell of Lethbridge Collegiate reports a trip to a lake within the city, while Bob McRae of Bonnyville Centralized started Unit 2 with a study of a nearby lake and river. Any body of freshwater can be used for these studies: pond, river, stream, slough or lake.

Should teachers wish to exchange materials they have developed for particular field studies, George Cormie would be pleased to receive these materials for posting on the Science Bulletin Board System and/or distribution to all field test sites.

20-Level Discipline Sciences

Courses of Study

To date, all units of these courses have not been completed. The generalizations below are based on teacher experience to the present. The last round of teleconferences in December, and forms submitted in the near future, will provide additional information.

Biology 20

Teachers and students are enthusiastic about the new biology program. They report there is sufficient time to do the field studies and integrate the STS connections so critical to this new course. George Cormie, biology program consultant, reminds teachers of the strong focus on ecology and field studies. A suggested time breakdown reflecting that focus, assuming 118 hours of class instruction, would be:

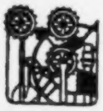
Unit 1	24 hours
Unit 2	15 hours
Unit 3	47 hours
Unit 4	25 hours

Chemistry 20

In chemistry, teachers have indicated that planning time for review of nomenclature and equations pays dividends in course coverage. This review can be streamlined by the assignment of practice problems for homework, reserving class time for dealing with difficulties. Some students have encountered problems with the mathematics of exponents and powers of 10 in the acids and bases section. Logarithms are not to be dealt with in this section. No other major problems have been identified. Alberta Distance Learning Centre is using the following unit/time breakdown for the course, assuming 105 periods of 67 minutes each:

Unit 1	35 hours
Unit 2	35 hours
Unit 3	17 hours
Unit 4	29 hours

Physics 20



Physics 20 teachers have raised the concern that Unit 1 and the course may prove a bit too long. Those teaching it on a semestered basis will be providing us with their total impression and specific advice in the near future. Other than concern with length, things are going well in Physics.

Two Resources Authorized for Each Discipline Program

Two basic student resources have been authorized for each of the new discipline science programs. Each student text covers both the 20 and 30 level of either biology, chemistry or physics, i.e. one book for the two years. In all three discipline courses teachers are satisfied with both resources although preference for one or the other varies from school to school. Some teachers find both resources equally satisfactory and are experiencing difficulty in deciding which resource to choose. Many teachers have spoken on the value of having both resources available to teachers and even to students where possible. These student resources are now available to all schools through the LRDC.

Several field validation teachers have been provided with teacher support packages by the various text publishers. Initial reaction to the teacher packages, either final or developmental versions, has been extremely positive. In some cases, laser video disks are being correlated to the text books with bar code reader strips. This opens up new possibilities in the classroom. Laser disks with direct and extensive curriculum fit are being seriously considered for authorization to support the new secondary science programs.

Student Counselling and Appropriate Placement Critical

Science 20 is not "Less Rigorous"

Several contact teachers have told us that students with weak background skills in mathematics and science are having difficulty with Science 20. In some cases Science 20 has been perceived to be for students less able in science and mathematics than those pursuing the discipline sciences. **This definitely is not the case.** The Science 20-30 route is for academically-oriented students interested in pursuing careers in areas such as business, the arts, or education. It is an integrated and challenging course that provides a broad background in science and is designed for those students who are not planning careers in science or engineering related areas. It is this group of capable students who would be well served by the Science 20-30 route.

Science 20 has a more quantitative approach than Science 10. A good mathematics background is essential for success in Science 20 as this course is as rigorous as the other 20-level disciplines. Students who are weak in science and mathematics will find Science 20 to be difficult. Science 14-24 is the route for students requiring remediation in science and mathematics.

Mathematics Requirements for Science 20

Field validation teachers have indicated the following:

a. Mathematics 13 provides sufficient background skills and concepts for students to succeed in Science 10. If a student barely passes Mathematics 13 prior to taking Science 10 that student may require additional help in the latter stages of Science 10.

b. Mathematics 10 or 23 provides sufficient background skills and concepts for students to succeed in Science 20-30. If a student barely passes Mathematics 23 before taking Science 20 that student may require additional help in the latter stages of Science 20.

c. Mathematics 14-24 provides insufficient background for the new senior high sciences, including Science 10-20-30. Students wishing to enrol in these courses should be counselled to take the mathematics courses listed above.

University of Alberta Acceptance of Science 30 - Update

As was previously announced, the University of Alberta has designated Science 30 a Group C course for admission purposes. Group C includes Science 30, Biology 30, Chemistry 30, Physics 30, Mathematics 30 and Mathematics 31. A document entitled *University of Alberta, Science Requirements by Faculty, Where Does Science 30 Fit?* has been provided to your contact teacher for distribution to your principal school counsellor(s) and all science teachers. Science 30 will provide strong background for the two first year science course series: Geography 130/Geography 131 and Geology 102/Geology 103. These are first year sciences recognized as fulfilling the science requirements of the Faculties of Arts, Business, Education, Native Studies and Physical Education and Recreation. Please refer to the document provided for further details. Additional copies of the "There's Science in Your Future..." document have also been provided to your contact teacher for distribution as the information on page 3 regarding acceptance by the University of Calgary, University of Lethbridge, NAIT and SAIT may be useful to you. Administrators, counsellors and teachers share the responsibility of conveying correct and current information regarding the nature of and possibilities for all the new senior high science courses.

Senior High Science Assessment Resources Project

The assessment resources packages developed for Science 20, Biology 20, Chemistry 20, Physics 20 are currently being field validated by you and your colleagues. These first draft packages were developed over a relatively short period of time (two months of weekends) by teachers who had not yet taught these new courses. We welcome specific suggestions for modification of the questions in these packages. The unit and final exams in these packages have a high percentage of higher mental activity questions and attempt to provide strong STS contexts. These questions were included for several reasons. First, many teachers either do not have the time or the access to resources that would provide contexts for the STS connections and HMA questions. Second, the new science program does require increased attention on conceptual understanding, integration of concepts and higher order thinking skills.

Due to the unique circumstances of each class, the use of the tests and exams without selection, modification and substitution to meet the your needs and the needs of your students is not recommended. For example, you may not have emphasized the particular STS context within a package question. If so, substitute one you have dealt with in the classroom and use the package question as a template to create new examination questions. As well, you may wish to include some knowledge and recall items to somewhat reduce the difficulty level of the test, or you may choose to test knowledge/recall items in quizzes as part of a formative diagnostic testing. Some of the tests may prove too lengthy for completion in one sitting, in which case you may wish to have more than one sitting or you may wish to make the test shorter in length. These resource packages are indicative of the direction evaluation is likely to take for the new programmes and should be used accordingly, tempered by your own professional judgement.

June Inservice at the University of Calgary

The 30-Level Field Validation Teacher Inservice is scheduled to begin the evening of Monday, June 21 and run until Friday, June 25 at the University of Calgary. The diploma exam scheduled for June 1993 runs from Wednesday, June 23 through Monday, June 28. Inservice participants will be back at their schools for Monday, June 28. The last operational day for most school jurisdictions is either June 29 or June 30.

The University of Calgary has offered the use of its facilities for this event and has struck a committee to work with Bev Romanyshyn on the planning of this event. It is anticipated that the basic plan of the four-day session will be similar to that followed at the University of Lethbridge, with your involvement in the selection of workshop topics.

Spring Information Sessions - For non-field validation teachers

Science Team and Field Validation Teachers to Provide Leadership

September 1993 brings in the implementation of Science 20, Biology 20, Chemistry 20 and Physics 20 to all Alberta high schools. To provide non-field test teachers with sample activities and assessment strategies, coupled with the latest program and resource information, members of the Curriculum Branch Science Team, assisted where possible by field validation teachers, will present several pre-registered day-long sessions around the province in March of 1993. Preliminary plans call for sessions in Grande Prairie, Hinton, Barrhead, Edmonton, Vegreville, Red Deer, Calgary, Lethbridge and Medicine Hat. Dates and locations as well as registration information will be provided in future issues of the *Science Teacher* and the Alberta Education publications, *Infocus* and *Connection*. School jurisdictions will be responsible for sponsoring teachers attendance at these sessions. Last spring, the six sessions offered were attended by over 400 teachers with Edmonton, Calgary and Lethbridge sessions being oversubscribed. It is hoped the addition of the three extra sessions will alleviate this problem.

The three-hour workshops entitled "Making Connections" offered at the recent ATA Science Council Conference will serve as a template for these spring information sessions. Activities will be set up around the themes of *change in a system*, *diversity*, *equilibrium*, and *energy and matter*. An information package which tracks the development of the knowledge, skills and STS connections for these selected Science 20 activities for Grades 7 through 11 will be provided. This package, developed by Monica Quinlan, classroom science teacher with Calgary Separate Schools, is useful to any educator faced with planning local inservice activities for the new secondary science programs for these grades. It is particularly useful for joint junior/senior high workshops designed to increase awareness of how the two programs articulate. For copies of this package, please contact Bev Romanyshyn at 427-2984. The addition of a strong assessment and evaluation component, and opportunities for discussion and questions, will round out each day's activities. Notice of these sessions will go to all school jurisdictions, and registrations will be taken by phone.

New Resources Available

*Brochures with detailed information and order forms have been provided to your contact teacher for all three resources described in this section.

Atlas of Alberta Lakes
Edited by Patricia Mitchell and Ellie Prepas
University of Alberta Press

This atlas provides recent and comprehensive information on 100 Alberta lakes. For each lake, the following information is provided.

- Non-technical information
  - Access, location, fisheries, land use and facilities
- Technical Information
  - Drainage basin, soils, plant communities, inflows, outflows and water quality
  - Water quality specifics-dissolved oxygen, ion and nutrient chemistry
  - Biological characteristics of plants including phytoplankton and aquatic macrophytes
  - Zooplankton and benthic invertebrates
  - Fish community - commercial, sports and domestic harvests
  - Wildlife species introduction and population changes in the immediate vicinity.

Aquatic Invertebrates of Alberta
Hugh F. Clifford
University of Alberta Press

A comprehensive new Alberta book for invertebrate identification associated with aquatic field studies. All major groups of Alberta's aquatic invertebrates are covered. Information on collecting sites, preservation and the biology of each group is provided. Numerous photographs and whole specimen drawings are included.

Science Curriculum Series - Case Studies
Developer and Supplier: Petroleum Communication Foundation

Give Your Science Students Fuel for Thought, a detailed brochure on this new resource package has been provided to your contact teacher. This resource package includes four excellent case studies which fit the Science 10-20-30 programs as well as the new Chemistry 20-30 program. Titles of the four case studies are:

Applied Chemistry: The Refining of Crude Oil (Fractional Distillation)
Environmental Chemistry: From Sour Gas to Natural Gas (Sour Gas)
Wise Use of Petroleum Resources: The Car in Our Daily Lives (The Car)
Industry and Society: The Development of Natural Gas in a Northern Community (Northern Development)

The case studies are well laid out with teacher notes, overheads and student sheet masters. Activities emphasize student involvement in background research, cooperative learning and role playing, and provide a strong focus on critical thinking. Background videos and print material which support the package are available upon request. The package is $25 and can be ordered and invoiced to your school by calling Tania Krueger at 264-6064 or faxing your order to 237-6286.

The Season's Greetings

AND ALL GOOD WISHES FOR THE NEW YEAR

Mary Ann Bird

Raja Panwar

Pam Shipstone

Stella Shum

Tania Pander

SCIENCE 20 TELECONFERENCE SCHEDULE
(Biology 20, Chemistry 20, Physics 20 comments also considered)

Series 1 Teleconferences – Unit 1 or unit currently teaching

Moderator: Raja Panwar
Recorder: Stella Shrum
In Attendance: Oliver Lantz, John Drader

Date	Contact Teacher	School	Phone	Fax
October 20 Tuesday 3:30–5:00	Bob McRae	Bonnyville Centralized	826–3366	826–2959
	James Versteegden	Camille J. Lerouge (R.D.)	342–4800	343–2249
	Lawrence Boyko	Central Peace (Spt. River)	864–3696	864–4076
	Tom Koch	Father Mercredi (Ft. McM.)	743–4200	743–3339
	Jim Nicolson	Foothills Composite (Okotoks)	938–6116	938–5437
	Dale Hobbs	George McDougall (Airdrie)	948–5935	948–4297
	Dave Watchorn	Glendon High School	635–3881	635–4176
	Ronald Bellamy	Millwoods Christian (Edm.)	462–2627	462–9322
	Dan Leskiw	Victoria Composite (Edm.)	426–3010	425–4626
	Yves-Daniel Mercie (Fr)	Ecole Heritage (Jean-Cote)	323–4370	323–3770
	Jacinthe Mouquin (Fr)	Ecole Maurice Lavallee (Ed.)	465–6457	468–0078
	Richard Fortin (Fr)	Ecole Notre Dame (Bnyvle)	826–3930	826–1934

Moderator: Raja Panwar
Recorders: Bev Romanyshyn
In Attendance: Oliver Lantz, John Drader

Date	Contact Teacher	School	Phone	Fax
October 21 Wednesday 3:30–5:00	Larry Albrecht	Brooks Composite	362–4814	362–0169
	Rozalia Andreiuk	Central High (Sedgewick)	384–3817	384–3635
	Tom Keller	Drumheller Composite	823–5171	823–4064
	Leo Himmelsbach	Grand Centre High	594–3386	594–7552
	Wes Irwin	Grande Prairie Composite	532–7721	532–6036
	Al Shea	Harry Collinge High (Hinton)	865–3714	865–5011
	Don Cross	Hugh Sutherland (Carstairs)	337–3326	337–3918
	Chris Isaac	Lester B. Pearson (Calgary)	280–6565	299–7158
	Tim Bell	Lethbridge Collegiate	328–9606	327–4387
	Pauletta Renkema	Lorne Jenken High (Barrhead)	674–3360	674–4525
	Myron Baziuk	Louis St. Laurent (Edmonton)	435–3964	425–8759

Moderator: Raja Panwar
Recorders: John Drader
In Attendance: Oliver Lantz

Date	Contact Teacher	School	Phone	Fax
October 22 Thursday 3:30–5:00	Tim Urlacher	Assumption Jr/Sr (Gr. Cntr.)	594–4050	594–3585
	Susan Ruzek	Hussar School	787–3781	787–3922
	Virginia Lo Pinto	John G. Diefenbaker (Clgy)	274–2240	274–7976
	Ian Kirillo (2nd Sem.)	Niton Central	795–3782	795–3933
	Henry Szydlik (English)	Notre Dame High (Bonnyville)	826–3930	826–1934
	Mark Schultz	Olds Jr./Sr. High School	556–3391	556–3375
	Gerry Vant Erve	Queen Elizabeth. (Edm.)	476–8671	478–8638
	Richard Nelson	Strathcona–Tweedsmuir (Ok.)	938–4431	938–4492
	Desiree Hackman	Sturgeon Composite (Namao)	973–3301	973–3230
	Lee Murray	Westwood Comp. (Ft. McM.)	791–1986	743–9663

SECONDARY SCIENCE CURRICULUM CIRCLE

[submitted by N A O'Haire and G R Thomas]

At the direction of the Curriculum Committee, staff convened a secondary science curriculum circle at Barnett House on 1993 11 16. In addition to staff and PEC representatives, twenty-four teachers attended from across Alberta. These individuals included teachers who have piloted the new science curriculum, are currently teaching Science 10, 20 and/or 30, and who are teaching grade eleven and/or twelve level physics, biology and chemistry. Also in attendance were science education professors who teach secondary science curriculum and instruction. Association representatives on Department of Education curriculum advisory committees were included in the above representation as well as representatives of the Science Council.

N A O'Haire called the meeting to order, explaining the workings of curriculum circles and outlining the expectations of the meeting. G R Thomas explained the specific reasons for convening the meeting, noting that the Association has received considerable representation from science teachers in recent months. He emphasized that the development and implementation of the Science 10-20-30 curriculum has been one of the most successful curriculum undertakings in recent times. However, since the spring, concern has mounted among science teachers about the courses, enrolment, content, etc. The focus of the meeting was to offer constructive advice to Association representatives for conveyance to appropriate Department officials; in this respect, the Association would work to improve the situation for science teachers across the province. N A O'Haire then led a paired interview activity that provided an opportunity for teachers to meet their colleagues and learn a bit more about one another.

Erich Berndt was then called on to provide circle members with information about the Minister's Advisory Committee on Secondary Science meeting held this past September. Mr Berndt made the same presentation to the members that he made to last month's Curriculum committee meeting. Gail Gislason, who was unable to attend the curriculum circle, submitted her summary of the same meeting and identified a number of problem areas and possible solutions in a document distributed to circle members. A question and answer session followed and members focused on the various science issues. N A O'Haire then divided the large group into four small groups and each group was asked to propose recommendations that would improve the situation for science teachers. Key recommendations were shared with the entire group and each small group's recommendations were submitted to staff.

A fairly solid consensus emerged. The core of the consensus is as follows:

1. Science 10-20-30 should be the normal science selection of senior high students who are academically inclined but *not destined* to postsecondary science programs or science careers.

2. If the above is to become the norm, students and their parents must believe that Science 30 is a valued subject and postsecondary institutions must accept it; further, there must be congruence between what postsecondary institutions *say* to students about the course sequence and what they really *mean*. The Department of Education should lobby forcefully to improve the acceptance level of Science 30. Improved recognition will increase enrolment.

3. The content in the current Science 10-20-30 program must be changed:
   --the content should be reduced

--there should be greater integration of science disciplines rather than chunks of disciplines
--a thematic approach should be introduced and encouraged
--activities should be emphasized.

4. The Department of Education must accept its responsibility to complete the inservicing of all Science 10-20-30 teachers.

Many other comments were expressed by circle members. Time did not permit a full discussion of these concerns or suggestions

- Many teachers expressed support for the development of a midstream science program (or even a Science 23 as a terminal science course).
- There was some feeling that the previous minister had listened too closely to science interest groups and that such interests do not necessarily consider or understand the reality of students or science instruction.
- A number of teachers felt that administrators should give the program an enrolment "break" to get the program established and that consideration should also be given to joint preparation time for Science 10-20-30 teachers (ie preparation time scheduled at the same time in the school day).
- More emphasis in department documents on skills, and less on knowledge or content objectives, would also assist some teachers.
- The issues of standards and testing were on the minds of some of the teachers who were concerned with interbranch coordination and cooperation (will we only know the "real curriculum" when the first Science 30 diploma exam is written?).
- Teachers are concerned that the student perception of Science 20 is that it is a harder course than the disciplinary sciences.
- Teachers were angry at the department's apparent perception that low enrolments are caused by science teachers and guidance counsellors and pointed to the need to get postsecondary institutions, parents and students (among others) on-side.
- Teachers were also angry at the department's statement that students should achieve at least 60 percent in Science 10 to succeed at Science 20; this adds to the perception that Science 20 is the hardest science course (and that perception is now "out there" and may be difficult to change). In this respect, some of the low enrolment problem has been created by the department.

In the view of staff, the meeting was an excellent one. There was a frank exchange of views and teachers wanted to be constructive in proposing solutions to existing problems. The results of the curriculum circle should be conveyed to the Minister of Education by the President and to department officials by staff as soon as possible.

Recommendation 1 That the President contact
the Minister of Education in order to convey
the results of the secondary science curriculum
circle.

GRT/lms, 1993 11 19

Lots of gloss and little content

University profs shoot down a high school science 'advance'

In the name of scientific literacy, Alberta Education has been working on new high school courses which will, according to the department's curriculum planners, enable students to think critically, have a firm grasp of scientific concepts, and "understand the relationship between science and technology and the role of science and technology in societal issues." They have hit a major stumbling block, however. The University of Alberta has rejected the proposed Grade 12 course, Science 30, as part of the qualification for admission to any U of A faculty. The reason: absence of substantive content and what associate dean David Beatty describes as "the *Time Magazine* approach to science."

Five new general courses (Science 10, 20 and 30 for the advanced high school diploma and Science 14 and 24 for a general diploma), included in Alberta Education's intended toughening of graduation requirements, are to go into use between 1990 and 1992. For the advanced diploma, Science 10 would be mandatory, plus 10 more science credits, or Science 10 to 30 could entirely replace the specialized courses—biology, chemistry and physics.

At present, the advanced diploma requires students to study at least one specialized science discipline to the Grade 12 level. Those headed for post-secondary science, of course, may take all three. They could still do that under the new plan, but only in Grades 11 and 12. Meanwhile, the three general science courses, for students contemplating non-scientific university careers, would be given about 30% more class time than a specialty presently gets.

High school teachers voiced their doubts. A mandatory Grade 10 general science course seemed illogical, the Edmonton school board observed, when students already had "nine years of general science which shares many of the goals and objectives and even repeats some of the same topics." And though the topics were "neat and glossy," a real science component seemed to be lacking in many of them.

University of Calgary reaction was also, to say the least, lukewarm, but the main blow came from the U of A. An out-and-out refusal by the province's biggest university is not easily dismissed. Not that the U of A disagrees with the aims of the curriculum revisers. "We have no quarrel with teaching students how science is applied," says associate dean Beatty for the Faculty of Science, "but not at the expense of giving them a good grounding in scientific concepts."

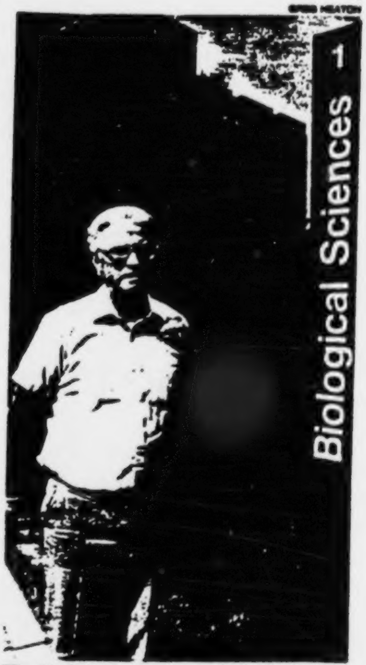
Here, Science 10 to 30 falls short of the mark, he says. An example of the "magazine" approach, for instance, is Science 10's medical unit. "It deals almost completely with the application of medical technology. There is no development of understanding, for instance, of such fundamentals as the nature of cells or tissue." Even U of A arts students must take two full-year science courses. Science 10, 20 and 30 will not adequately prepare them.

Ronald Cammaert, high school associate director for Alberta Education, denies the lack-of-content charge. "The message we're getting from the universities is 'Send us critical thinkers.' " That's what this program is all about, he says, and obviously you can't teach critical thinking without teaching something to think about.

But perhaps the curriculum designers should have talked more and sooner with the U of A, Mr. Cammaert concedes. That's what they'll be doing this fall, trying to reach some compromise on "content." "There's no reason why we can't put together a suitable course," says Prof. Beatty, "but as it stands now it's a prescription for disaster."

—*Greg Heaton*

GREG HEATON



The U of A's **Beatty:** *Prescription for disaster.*